JUN 30 1943

Gas Journal

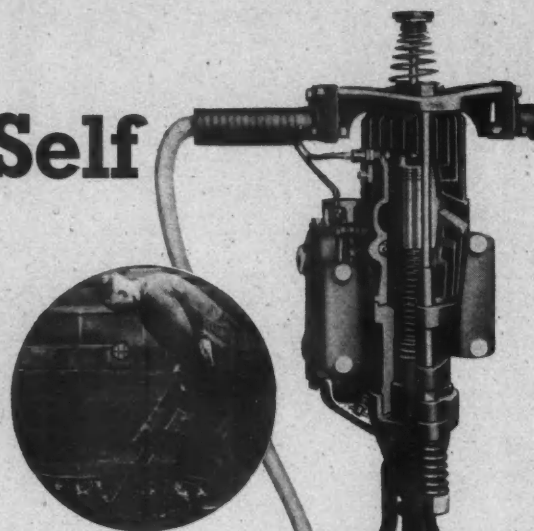
LIGHT - HEAT - POWER - BY-PRODUCTS

ol. 241. 95th Year. LONDON, JUNE 9, 1943. Registered as a Newspaper. No. 4177. Price 1/-

The Badge

of Merit

Self-Contained



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This Pegson Road Ripper needs no compressor or pipe line. It will deliver approximately 1,500 powerful blows per minute. It runs on Pool petrol, at a fuel and oil cost of but threepence an hour. It is fitted with press-button control, automatic lubrication, and weighs but 89 lb. The Pegson Road Ripper s an all-purpose tool that can be handled by unskilled labour. It will do any job of concrete demolition, road ripping, clay digging or light pile driving. It will take any tool with a 1¼-inch hexagonal shank. It is the handiest of all rippers on the market.

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- Their reliability is proved by repeat orders received constantly for Regulators and Governors of all types.
- Many Gas Works have thousands in use.
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GAS WORKS PLANT ENGINEERS, CHESTERFIELD.

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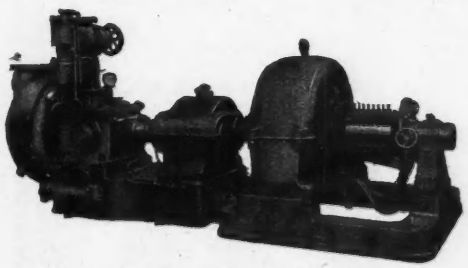

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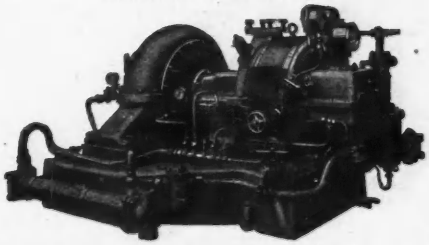

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GAS JOURNAL, JUNE 9, 1943

VOL. 241 95th YEAR No. 4177

EDITORIAL NOTES

INSTITUTION MEETING

As we write this short note on the eve of the 80th Annual Meeting of The Institution of Gas Engineers we cast our mind back to 1939. With considerable physical exertion we have taken down from our shelves Vol. 226 of the "JOURNAL" covering the months April to June of that year. It is pleasant to feel the texture of the paper; the printed word stands out black and bold and the open white spaces and display type speak of different days. Our three "Institution Numbers" dealing with the 1939 meeting in print and picture contained 340 pages. Those were the days when Institution meeting meant Institution week with a round of social visits and functions; on June 6, 1939, 1,160 guests attended the President's reception and dance on a stiflingly hot night, and a good time was had by all.

Circumstances have changed somewhat. The 1943 meeting, like its wartime predecessors, will be a utilitarian one-day businesslike affair as befits the times. However, we confidently anticipate a general atmosphere more optimistic than was reasonably possible twelve months ago, and we feel sure that Mr. E. V. Evans will occupy the chair with charm and distinction. His Presidential Address, published in full on later pages, is quite outstanding, and we are glad to be able to print it so that it can stand on record for the outside world. We have very little paper, so little that the Address alone constitutes our first "Institution Number"; and it will not be possible to spread ourselves after the meeting and publish with a flourish further Institution Numbers on the grand pre-war scale. We neither complain nor offer apology. Our readers may expect austerity issues—and they will get them. We have endeavoured to develop skill in the rather difficult art of making a pint pot hold a quart. To what degree we have acquired the art we must, of course, leave our readers to judge. Last year it took several issues of the "JOURNAL" to cover the Institution meeting, as we thought, adequately. We see no alternative in regard to this year's meeting. Members of the Institution will have had their blue books. After the meeting—some time after—the Papers will be republished to embody the discussions, written contributions, and replies, and the sum of half-a-crown will purchase the pot-pourri. There is, then, nothing in the nature of a journalistic scoop about Institution "copy."

But there is the "outside world" to consider. We may, perhaps, be forgiven for indulging in the thought that "JOURNAL" readers, even in wartime, are not asked to queue-up for news. Catering for immediate needs, we shall deal with Institution fare speedily enough, and we hope to serve it in digestible form; the while, with an eye to the future as well as the present administrator, accountant, engineer, chemist, secretary, or researcher, preserving tangibly for reference, in war as in peace, a continuous and accurate record of thought in the Industry—a record on which all can rely.

DOMESTIC LIGHTING

WHAT is to be the Industry's attitude to domestic lighting by gas after the war? Not long ago we had a report by the British Gas Federation submitted to the Design of Dwellings Sub-Committee of the Central Housing Advisory Committee of the Ministry of Health. Presumably that report conveyed the recommendations of the Industry speaking, as it were, in a general sense, and it contained this statement: "Generally speaking, electricity will be used for lighting in future housing." A news item in our issue to-day refers to a new canteen on a gas-works; in these new premises electricity is employed throughout for lighting. We mention this subject of domestic lighting again in view of the fervent appeal of Mr. A. E. Pask in last week's "JOURNAL." "I beg of the Industry," he said, "to make domestic lighting one of the post-war planning objects. I sound a warning. It is admitting failure by its present attitude." Which is the right view—that of the Industry as expressed in the B.G.F. report to the Ministry of Health, or the individual view expressed by Mr. Pask? And we must add that Mr. Pask is not alone in his opinion, which he voiced in his Presidential Address to the Wales Association. Several gas engineers and managers in Wales have done well with the lighting load. Just before the war Mr. Clark Jackson, of Neath, was outlining his experience, mentioning that between 1931 and 1939 the gas-lighting burners in use, far from declining, had increased from 19,000 odd to nearly 28,000—and the users were thoroughly satisfied with the service. We could quote other examples from Wales and from other parts of Great Britain. Have Mr. Pask and Mr. Jackson and several others we could name been misguided or mistaken in their policy?

The argument that Mr. Pask employed was that electric lighting would not have gone ahead if the Gas Industry had been sufficiently interested in the lighting load and had constantly modernized its lighting equipment. On their part, the manufacturers of gas-lighting equipment were quite prepared and were fully capable, but most gas undertakings were quite unprepared to buy and install good lighting burners and fittings; most gas undertakings, in the view of Mr. Pask, let things slide—unnecessarily and without thought. But is that the only reason for the advance in domestic lighting by electricity? Economics and load building apart, which illuminant would the public ask for—electricity with modern equipment or gas with modern equipment? And we must bear in mind that "fitness for purpose" in accord with national interest and consumer service is somewhat important. It is a conception which must override the sectional interests of any one fuel industry or light-giving agency. So we would ask: Is it because of inferior service by gas undertakings that the majority of people have come to prefer electricity to gas for lighting their homes, or is it that electricity is, taken all in all, a medium better fitted for the purpose? If we take coal as the raw material of light, which, of course, in this country it is, is electric light or gas light the more efficient illuminant?

We think we know the advantages of gas lighting. As an illuminant *per se* gas is a pleasantly diffused source; it is amenable to delicate adjustment of light output, controllable at will. Financially, the lighting load is a "good egg" for any gas undertaking—that is, from the accountant's point of view. But if gas as an illuminant is not fundamentally sound from the standpoint of the user, then it follows that the pushing of the gas-lighting load is bad business, and is calculated to affect adversely other gas loads, loads for which gas is outstandingly suitable and acceptable. And we are convinced that the future prosperity and progress of the Gas Industry will depend more than anything else on the "acceptance factor." It would indeed be unfortunate if the public developed a nasty taste about gas because the virtues of gas lighting were dinned into their minds by every conceivable form of publicity. We are not saying that such a taste would be developed, but in common with Mr. Pask, but on different grounds, we too sound a warning. In brief, we must be quite sure that in advocating gas lighting for the home we are acting in the best interests of the consumer, which is only another way of saying in the interests of the Gas Industry. And we feel that a particular case must not be considered as constituting a general rule.

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proving or would prove highly acceptable from all angles; but, we reiterate, not to us does the particular case constitute a general rule. The purpose of this note is to look at the matter broadly and face facts unashamed and without pretence, and we must ask ourselves which is the better conclusion,—that of the B.G.F. or that of Mr. Pask. And we take it for granted that electricity is needed in the home—needed for specific purposes for which, it seems to us, it is pre-eminently suited. Ought we to consider with such "accepted" uses as the radio and the vacuum the use of electricity for domestic lighting? The question appears to us pertinent enough, as also does the query whether gas lighting should be given added marks and added commendation because it is also automatically a source of much sensible heat. A gas-lighting burner is, of course, a "background" heater. In wartime and with the urgent need for fuel economy it is for this reason a double boon and blessing. And irrespective of war, it is a fact that the seasons of the year which call for artificial light are the cold seasons, that the demand for artificial light coincides, and in direct proportion, with the demand for warmth. Ought we, therefore, to "sell" our gas lighting on the "warmth factor"? On the face of it a communal benefit. On the other hand, if we were installing background heating should we position our units where we have to place our lighting burners? And, in fact, does a dirty ceiling tend to accompany the burning of clean gas in a clean lighting burner? We ought to know. We have had gas lighting in our offices since 1849. Such are some of the thoughts which occur to us about the domestic gas-lighting load. What do our readers think should be the policy of the Gas Industry in regard to this load?

Personal

Among the names in the Birthday Honours List are those of Dr. E. S. GRUMELL, Chairman, Fuel Efficiency Committee (C.B.E.); Mr. A. W. SMITH, General Manager and Secretary, Birmingham Gas Department (C.B.E.); Mr. C. H. CHESTER, Gas Engineering Adviser, S.W. Region (O.B.E.).

* * *

Mr. EDWARD H. HART, Engineer and Manager to the South Molton Gas Department, has been appointed Manager of the Bridgnorth Gas Undertaking in succession to Mr. R. J. Bradshaw, who is shortly leaving to take up an appointment at St. Helens.

* * *

Acting upon medical advice, Mr. WILLIAM NORRIS will shortly retire as Engineer and Manager of the Burgess Hill and St. John's Common Gas Company after 23 years' service.

Obituary

The death occurred on June 5 of Mr. J. L. BUTLER, Managing Director of Messrs. W. J. Jenkins & Co., Ltd.

* * *

As a result of a street accident the death has occurred of Mrs. A. M. KEILLOR, wife of the Manager of the Earlston Gas Company, Ltd., Berwickshire.

Diary

June 21.—London and Counties Coke Association, Gas Industry House.—Finance Committee, 11 a.m.; Executive Committee, 11.30 a.m.; Central Committee, 1.30 p.m.
June 23.—Industrial Gas Centres Committee, Gas Industry House.
June 24.—Midland Association—Meeting in Birmingham, 2.30 p.m. Address by Dr. J. G. King, Director of the Gas Research Board.
June 25.—Waverley Association, Edinburgh, 10.30 a.m. Presidential Address of Mr. W. M. Henderson.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

Yorkshire Gas Coke Association

In its second annual report the Association remarks that the National Federation of Gas Coke Associations is continuing its excellent work, particularly in regard to co-operation with Government Departments, and a Merchants' Consultative Executive Committee has been formed by the Ministry of Fuel and Power on which Colonel H. C. Smith (Chairman), Mr. W. L. Boon (Technical Adviser) and Miss C. A. Wooster (Secretary) are the Federation's Representatives. Regular monthly meetings of the General Committee are held in London, the Association's representatives being Mr. G. E. Currier and Mr. Charles Bateman, and also District Secretaries' meetings are held each month, of which Mr. Bateman is Chairman.

As a member of the National Policy Committee, the Association's Chairman, Mr. G. E. Currier, attended several meetings with Sir William Beveridge on the question of coke rationing.

The National Tripartite Technical Committee is continuing its excellent work under the direction of the National Policy Committee, Mr. W. I. Ineson (Chief Chemist, Bradford Gas Department) being the representative of the Yorkshire Gas Coke Association.

Several meetings of the Joint Coke Committee have been held during the year. Mr. P. Spragg has continued to fill the office of Organizer, and of Price Co-ordinator, for the Yorkshire Associated Coke Producers. He has visited the Midland Counties Coke Association, and given a detailed survey to the Joint Committee of the operation of the Distributors' Branch in that area. The finances of the Yorkshire Associated Coke Producers are maintained jointly by the Coke Producers' Federation, Ltd., and the Yorkshire Gas Coke Association. Good progress has been made in co-operation with the North of England Coal Traders' Association, and the Yorkshire Coal Merchants' Association, towards the formation of a Distributors' Branch for Yorkshire.

A Tripartite Sub-Committee has been formed. Gas Coke representatives are Messrs. G. E. Currier, N. Hudson, J. E. Lister Cooper, and C. S. Shapley, who have prepared an amended Draft Agreement for the operation of this Branch, which it is hoped will soon be adopted by the three bodies concerned.

The report concludes: The Gas Industry has always produced and supplied two smokeless fuels—gas and coke—and it is likely that it will continue to do so for a long period ahead. The need for the elimination of waste in the use of coal, which is the nation's greatest mineral asset, becomes more and more urgent, and the economics of the post-war period will also demand the most economical use of coal. This, together with the growing urge for cleaner towns and cities, will require the carbonizing industries to produce their two smokeless fuels to the maximum. It is, therefore, incumbent on every coke producer to continue to improve the quality and the grading of coke for all purposes, in order that the requirements of markets may be adequately supplied. It is becoming more and more generally recognized that the carbonizing industries treat coal by the most economic and efficient processes, and that the useful heat obtained in the form of gas and coke from one ton of coal is equivalent to the useful heat obtained from the burning of 1¼ tons of raw coal.

Coal Tar Naphtha and Xylole

The Minister of Fuel and Power announces that in pursuance of Regulation 55 of the Defence (General) Regulation, 1939, he has made the Control of Coal Tar Naphtha and Xylole Order, 1943 (S.R. & O. 1943, No. 768).

The Order, which came into force on June 1, is similar to the Control of Coal Tar Naphtha and Xylole Order, 1942, which it supersedes. The main revisions are in Part 2 of the Order (which deals with prices). Power has been taken to fix, by permit, a special increased or decreased price which substitutes the price specified in the permit for the applicable price specified in the Second Schedule to the Order. Prices, whether specified in the Schedule or in a permit, attract any applicable increases or deductions authorized or required by the Provisions of the Order.

Changes have been made in relation to the sale or supply of controlled products in small containers (Article 22), and the sale or supply of small quantities in containers holding less than one gallon have been excluded from price control (23).

All applications for licences, permits, &c., must be addressed to the Minister of Fuel and Power, Dean Stanley Street, London, S.W. 1.

Mr. David Jacobs, of J. H. Robinson & Co. (Liverpool), Ltd., has been appointed Sales Manager to the Company. His headquarters will remain at Manchester.

The Annual Meeting of the Waverley Association of Gas Managers will be held in the Y.M.C.A. Hall, 14, South St. Andrew Street, Edinburgh, on June 25 at 10.30 a.m. Mr. W. M. Henderson (Dalkeith) will preside and will deliver his Presidential Address. Subsequently there will be a luncheon at the North British Station Hotel.

In Collaboration with the City Electricity Department, the Leicester Gas Department recently arranged a Home Front Brains Trust. This meeting was sponsored by the local branches of the Electrical Association for Women and the Women's Gas Circle, and was held on June 1 at the Bell Hotel. The theme was "From Plot to Pot." Mr. Freddie Grisewood of the B.B.C. acted as Question Master, and a panel of experts answered questions on the growing and the cooking of food, and its vital importance to health. There was an excellent attendance at the meeting, which proved most successful.

Newport (Mon.) Centenary

The hundredth birthday of the Newport (Mon.) Gas Company was celebrated in fitting style on May 31, when the Company dined together at the King's Head Hotel. Major Julian Day was in the Chair and nearly 200 were present. Among the guests were the Mayor of Newport, the Chairman of the Monmouthshire County Council, Sir Reginald Clarry, M.P., and Major-General Sir Neill Malcolm, K.C.B., D.S.O. (Managing Director of British Benzol and Coal Distillation, Ltd.). The whole proceedings reflected the mutual esteem in which Directors, Staff, and "Rank and File" (men and women, almost equal in numbers, it seemed) hold each other, and the complete harmony which exists between technical and administrative branches of the Company and between these and the public whom they serve. Here, apparently, is a case where history is painting the "holding company" movement in brilliant colours.

Sir Reginald Clarry proposed the toast of the evening, and Major Julian Day responded. Mr. G. M. Gill proposed "The Staff and Workmen," to which Mr. Rust, Mr. Snelling, and Mr. Willey (the Works Superintendent) replied. Major-General Sir Neill Malcolm and Mr. R. J. Auckland (Director, Manager, and Secretary of the Cardiff Gas Light and Coke Company) replied for "The Guests," proposed by Mr. R. Wilson Bartlett. That the live interest in technical education preached and practised by the late Mr. Thomas Canning still flourishes was evidenced by the fact that the Centenary Dinner was made the occasion for Mr. J. H. Canning to speak on the Company's educational policy and for presentations to the five recent newcomers to a long list of successful students.

In the brochure, a copy of which was presented to each guest, we read that "Mr. J. H. Canning, as his father did before him, made the well-being of employees a matter of paramount consideration, and endeared himself to every member of the staff." Since it is manifest that the present Directors and Staff preserve that same ideal and enjoy the same affection, we have no doubt that the Newport (Mon.) Gas Company can look forward to another century of useful and enjoyable service to the community.

Midland Association

The Spring Meeting of the Midland Association of Gas Engineers and Managers was held at Wolverhampton on May 27, when a visit was paid to the Gas-Works, of which the President, Mr. A. H. Cranmer, is Engineer and Manager. Following a tour of inspection there was luncheon at the invitation of the Directors of the Wolverhampton Gas Company. In proposing the toast of "The Town of Wolverhampton," Mr. George Dixon (Nottingham) said the Gas Industry was out to serve all manufacturing industries, and Wolverhampton was an excellent example of how best to fulfil the true function of the Industry, to develop and to serve in the post-war world. Dr. Byrne-Quinn, Mayor of Wolverhampton, responding, expressed appreciation of the efficient service of the Wolverhampton Gas Company.

Dr. E. W. Smith, C.B.E., who received a very hearty welcome, referred to the great satisfaction it gave to him as an old Midlands man to attend the meeting. He felt a little miserable at the present state of organization in the Gas Industry, not because it was bad, but because it might be so much better. He thought the attitude of the Industry to Government departments should be one of some vigour rather than one of pleading, because it was not the function of a Government department to initiate new departures.

Mr. A. H. Cranmer, the President, in responding to the toast of "The Association," expressed appreciation at the large number present.

Mr. A. W. Smith, Birmingham, in proposing the toast of "The Wolverhampton Gas Company" coupled with the name of Mr. Neve (Chairman), thanked the Company for their hospitality and the opportunity of a visit.

Mr. John Cecil Neve, responding, congratulated Mr. A. W. Smith on his election as a member of the Gas Advisory Board.

The Directors fully appreciated the good work Mr. Cranmer had done and was doing, and it gave them the greatest pleasure to support him in all his undertakings in connexion with the Midland Association and other Associations with which he was connected for the development of the Industry as a whole.

In the afternoon a visit was made to the works of Messrs. Henry Meadows, Ltd., where the members were welcomed by Mr. W. Wilson Hamill, the Managing Director. Tea was subsequently served in the canteen. A vote of thanks was proposed by Mr. A. H. Cranmer and seconded by Mr. W. G. S. Cranmer. Mr. J. L. Chaloner, on behalf of Messrs. Henry Meadows, Ltd., acknowledged the vote.

Municipal Year Book

Founded in 1897 by Sir Robert Donald, the *Municipal Year Book* (Municipal Journal, Ltd., 42s.) has made its 46th appearance in form little different from peacetime, and in substance more than ever true to its sub-title, "Encyclopaedia of Local Government Administration." With many emergency duties added to its normal vital health services, local government is being brought into direct association with numerous organizations and trade and other interests, and its personnel is substantially aided by a volume of over 1,300 pages of information necessary for wartime administration. The Minister of Health, in his preface, pays tribute to the way local councils have risen to their new tasks, great in size and number, and looks forward with enthusiasm to the resumption of the great housing work of the Ministry and local bodies in association, which must aim at planning and providing accommodation which will allow of a full and healthy family life for all. The year 1942 is reviewed in detail in regard to legislation, finance, rating and valuation, roads and transport, education, health, welfare, salvage, public utilities, police, and other services. Much of what is written about fuel and power is familiar, and it is appropriate to comment that if, as they no doubt are, all the other sections are as completely informative and unprejudiced, the ground of municipal government is very well covered.

The Year Book takes a look at the future too, and deals in a special section with the views put forward by several local government associations on the changes necessary to adapt administration to the needs of the new world. A mass of proposals, many of them contradictory, is put forward. The county borough is widely favoured as a convenient unit, but this proposal does not find favour with the county councils, and there are exceptions in the case of sparsely populated areas and purely rural districts which oppose " the elimination of traditional local government by carving up England and Wales into regions under officials appointed by and controlled from Whitehall." But larger areas than those of any existing or future authority would not be ruled out for the administration of such services as public utilities, certain branches of education, and some institutional services.

Gas-Works Canteen at Salford

On May 19 the Mayor of Salford, Mr. C. J. Townsend, officially opened a new Gas-Works Canteen at Salford. The building is essentially utilitarian and is modern in design. An interesting feature is that it is built on a railway tunnel and on filled-in ground. The foundations are mass concrete piers bearing directly on the tunnel arch, and the walls are supported on reinforced concrete beams, supported in turn on mass concrete piers. The building is 123 ft. long by 34 ft., giving an area of 4,182 sq.ft.

The accommodation comprises a dining hall to seat 100, a kitchen with essential stores, men's wash room and locker room, women's wash room and locker room, and fire-watchers' room with recreation room immediately above.

The kitchen is equipped with gas-operated equipment, consisting of hot cupboards, double oven range, pudding steamer, fish and chip range, vegetable boilers, potato peeler, potato chipper, and a " Magna" boiler, with a galvanized hood, complete with extractor fan for ventilation, &c. It is planned for service on the cafeteria principle. Heating is provided by means of pipes and radiators using a steam supply from the works through a calorifier. The building is electrically lit throughout.

Kensington Blood Transfusions

No fewer than 2,486 blood donors registered between May 24 and 29 in the Kensington Blood Transfusion Drive. The drive was launched by the Mayor, Councillor R. C. D. Jenkins, J.P., L.C.C., at the Church Street Showrooms of the Gas Light and Coke Company, where tests were taken throughout the week. The Mayor was the first donor to enrol. Among other distinguished Kensington residents who had tests taken were Madame Maisky and Squadron-Leader Paul Bennett, V.C., M.C. The North African Campaign has made such inroads on the stocks of dried blood stored all over the country that a series of special drives has become necessary. So far about one in twenty of the population of Great Britain has enrolled as a donor, but in view of expected developments this no longer provides a safe margin. The actual transfusions of the Kensington Blood Donors will take place in the local Gas Light and Coke Company Showrooms towards the end of June.

Squadron-Leader Paul Bennett, V.C., M.C., has a blood test while the Mayor, Councillor R. C. D. Jenkins, J.P., is seen behind waiting his turn. Mr. A. E. Sylvester, Managing Director of the Gas Light and Coke Company, is also waiting. Squadron-Leader Bennett left the Magisterial Bench for a moment to have his test taken.

INSTITUTION OF GAS ENGINEERS

PRESIDENTIAL ADDRESS

[Communication No. 258]

By E. V. EVANS, O.B.E., F.I.C.,

Director and General Manager, South Metropolitan Gas Company

Introductory

It is usual in a Presidential Address to survey the diverse aspects of the Gas Industry and the work of the Institution, dealing particularly with changes or developments that have taken place during the year of office. On this occasion I propose to depart from precedent and to deal with the present position of the Gas Industry in the national economy, attempting also to indicate the greater responsibilities it will be required to discharge in the future.

The simple fact of the growth of our Industry to its present size and ubiquity is, in itself, sufficient proof that it performs a necessary public service. The heavy demands made upon the resources of the Industry during the present war are adequate confirmation, if any were needed, that it has a real place in the national economy. While we who serve this Industry have little doubt as to its value and importance, it is well that we should examine the basis of our belief and state that basis in a manner that may be understood by those less familiar than we are with the responsibilities we endeavour to discharge. We should go further and, having ascertained the present function of the Gas Industry in the national economy, attempt to visualize the contribution that we can make in the future. To do this ideally we should need to be unbiassed and yet adequately informed. I cannot claim to be unbiassed, for as your President and as one who has devoted a life-time to the Gas Industry I have acquired a bias in its favour. But, with this limitation, it is still possible to analyse the functions and achievements of the Gas Industry, having regard first to the public interest and not primarily to the interests of the Industry itself. In doing so it is conceivable that we might be led to wonder if the public supply of gas was a service that had fulfilled its function in the past but, with advancing knowledge and improved technique, was due to be superseded. If that were indeed the case, it would be our public duty to recognize the facts and to ensure that the supersession should take place with the minimum dislocation of our national life, and with the minimum of hardship or inconvenience for those towards whom our Industry has a responsibility. Fortunately, this is not the situation that we have to face. The analysis reveals that our functions as a constituent part of the national fuel industry are at present of major importance and can well become of far greater importance.

It is essential for the good of the nation that considerations of political or commercial opportunism should not rule the future development of so important a part of the national economy as fuel usage. The problems involved are fundamentally technical and economic, and satisfactory solutions will be found only if full weight is given to these basic technical and economic aspects. On such grounds it is possible emphatically to state that development of gas supply on a scale much beyond our present record would confer large benefits upon the community.

I do not apologize for speaking on such a theme in the midst of a war which must be won before we can be certain of the freedom to choose those lines of action which are right and proper. Towards the winning of this war the Gas Industry has been, and is making, every effort, and will not fail to heed the admonition of the Prime Minister to keep its eye on the ball; but throughout all these endeavours we are convinced that we shall achieve victory and when that task is accomplished we shall be faced with the reconstruction of our national life and the need to carry a considerable measure of responsibility in respect of other peoples. This we shall not do effectively unless our basic industries know and are fully prepared to play their appropriate parts. Our responsibilities are inevitably linked with those of many others and unless we have defined the contribution we can make we shall hamper the co-operation which is indispensable to success.

The Importance of Coal

The importance to this nation of a rational fuel policy has been emphasized by many writers and speakers who have recognized that this densely-populated island has few natural resources from which to win a livelihood. The fertility of the land, the underground deposits of coal, and the skill of the people are, indeed, our only major assets. Neither of our two main natural resources are unique in the world, and the economic greatness of this country has been due to the skill and inventiveness that has been shown in using them. Although Great Britain took the lead in using her natural resources for the development of great manufacturing industries and, thereby, acquired a premier trading position in the world, this lead will not be maintained without strenuous endeavour. Other countries also have natural resources, some in greater variety and extent than our own. With these resources great industries have been built, and the speed of industrialization has been accelerated very much by the two great wars of this century. Prosperity, certainly, and even survival as an influential economic power, will depend upon our ability and determination to use in the wisest manner, and with the maximum efficiency, our own natural resources.

Fuel, in Great Britain, means coal. We have no petroleum deposits of any consequence and water power is available on only a very limited scale. It is, therefore, of little avail to consider the adoption in this country of methods that have proved successful in places where the basic resources are entirely different.

The fact that our indigenous coal deposits have been computed as sufficient to last, at the present rate of consumption, for some five to seven centuries does not condone their extravagant use. Coal has to be won from the ground in a manner that is arduous and costly. The more easily worked deposits have naturally been exploited first and increasing difficulty of winning, together with the need to avoid wastage of man power, will make it more than ever necessary to use coal efficiently.

The Deficiencies of Coal as a Fuel

Coal is required to provide heat, light and power in homes, offices and factories, and as a chemical raw material in the metallurgical industries and in the chemical industry. For few of these purposes is the coal as mined really suited for use without some mechanical preparation or conversion to other forms. Coal can supply the energy needed for transport, whether by land, sea or air, but the disabilities attached to its use have led transport to rely largely upon the more convenient fuels of foreign origin.

Potential chemical energy stored as coal underground is a long way from the heat or power required for the multitudinous purposes of a highly-organized community, and between the two there lies a succession of operations. To make this store of energy available involves mining, transmission in bulk from the pit-head to centres of population, distribution of appropriate quantities to individual users, and utilization of the energy for the purpose required. At every stage in these operations coal exhibits numerous disadvantages and inadequacies, redeemed only by the single feature that it is a concentrated store of energy in a form which can be retained for use when needed without substantial loss. As a fuel for the supply of heat, coal suffers from the presence of both ash and sulphur, which provide the problems of ash disposal and of sulphur pollution of the atmosphere. Its combustion is not readily controlled because the evolution of volatile matter requires more air in the early stages of combustion, while less air is required after the volatile matter has been expelled. If this control is not adequate, smoke will be added to sulphur as a noxious constituent of the atmosphere. The coking properties of many British coals add to the difficulty of ensuring

the controlled air supply which is essential to efficient combustion. The handling of the solid fuel is an arduous and dirty operation, particularly if the scale of operation is not large enough to justify mechanical handling. In less, but still serious degree, the disadvantages of coal compared with a fluid such as petroleum are apparent in the operations of winning, bulk transmission and distribution.

The practical effect of these drawbacks is seen by the degree to which petroleum fuel oil has replaced bunker coal in the ships of this country, even though we have the coal but need to purchase the fuel oil overseas and bring it long distances to our ports. In the U.S.A., where both coal and oil are indigenous, petroleum was supplying about half the total fuel requirements of the country.

Methods of Coal Treatment

These limitations and deficiencies of coal in its raw state have led to the development of specialized branches of fuel technology aiming at providing the energy obtainable from coal in a form which lends itself better to efficient, cleanly and convenient use for specific or general purposes. It is appropriate to consider the various lines of development under the headings of the technical principles involved.

(a) *Mechanical Methods*

In this category come the colliery operations of ash removal, breaking and screening. By removal of some of the ash from the coal at the colliery, the task of the coal consumer has been materially lightened and the sulphur content of the coal is usually reduced. The extent to which ash can be removed is limited by the intimacy of its admixture with the coal and the amount of combustible matter that it is permissible to reject with the discarded ash. Breaking and sizing coal makes it possible to supply to the user a product of more uniform character, better suited to mechanical handling and mechanical stoking. By using coal in the pulverized form it is possible to endow it with some of the advantages of a fluid fuel. Such devices do much to mitigate the natural disadvantages of coal as a fuel, but their use is of necessity restricted to the relatively large user who can afford the cost of installation and maintenance. The development of such mechanical methods requires careful co-ordination if it is to proceed on an extensive scale. Coal cannot be broken into one single size alone (except dust), and it is clearly important that the requirements of appliances using each particular size should be correlated closely with the means of producing that size and with the ability to sell and use the other sizes produced at the same time.

Mechanical methods do much to ameliorate the conditions of handling and use, but they are a mitigation rather than a removal of fundamental inadequacies.

(b) *Physical Conversion*

Physical conversion of coal (as contrasted with the chemical processing of coal) may be defined as the liberation of its energy by combustion and the transmission of this energy either as heat or electricity. The term "physical conversion" is used because the process involves the conversion of potential chemical energy in the coal to kinetic energy in the molecules of the heat-transmitting medium or in the electrons of the conductors.

Because the combustion of coal can be conducted more efficiently, and with fewer disadvantages, on a large scale than on a small scale, there is the possibility of improving the utilization of coal by carrying out this combustion at large central stations and conveying the energy to the point where it is required. The transmission and distribution of heat energy in steam or hot water has not been developed to any great extent in this country, although in other countries where climatic conditions are different it has been adopted with some success. In Great Britain, it is more usual to convert the heat energy into electrical energy and distribute it in that form. The convenience of energy supplied in this manner has led to rapid development of the process, and to large improvements in power production, transport and communications.

It must be remembered, however, that when the chemical energy of coal is converted to heat by combustion there takes place a change in the quality of the energy which may be described as a fall in energy level or, in thermodynamic terms, an increase in entropy. This is not necessarily a disadvantage if the heat is to be used as such. When that heat energy is up-graded to such forms as mechanical power or electrical energy this can only be done with a substantial loss, which, however, is justifiable for such specialized purposes as power or communications. On the other hand, when that up-graded energy is used for the production of heat normally required for domestic purposes it represents a wasteful series of operations.

Physical energy in the form of heat or electrical energy has the drawback that it cannot be stored or distributed without loss. It may be converted temporarily to other forms, such as the potential chemical energy in an electric accumulator or the potential energy in water raised to a high level, but all such methods are inefficient and have proved excessively costly. Thus, for loads of an intermittent character, a large proportion of the conversion plant must be operated for only a small part of the time, with inevitable high cost per unit of energy consumed.

(c) *Chemical Conversion*

A third principle employed in fuel technology involves the conversion of the potential chemical energy of coal to potential chemical energy stored in a substance more suitable to the use for which it is required. The new substances may be solid, liquid or gaseous and may have properties differing only slightly or differing very widely from those of coal. The variety of processes employing this principle is very wide and includes such operations as carbonization, gasification and hydrogenation, as well as the more complex combinations of processes employed in the synthetic chemical industry. From these processes there may be derived products which find uses not only as fuel, but also as structural materials or as the raw material for further chemical operations. It is characteristic of all the products of chemical conversion that they can be handled, distributed and stored without loss (except that due to accidental spillage or leakage) and the energy is concentrated in a small weight of material, making for low cost of storage and distribution.

Over 20 per cent of the total coal required for use in Great Britain is subjected to chemical conversion processes before use, mainly by the coking and gas industries, each of which processes over 10 per cent of the coal required for home use. The coking industry is primarily concerned to produce coke as a chemical reducing agent for iron ore, but it produces gas and tar also. The Gas Industry is primarily interested in producing and distributing fuel in gaseous form, but has given much attention to the development of coke as a smokeless solid fuel and to tar as a raw material for chemical and constructional uses and as a liquid fuel. Great Britain has great need of liquid fuels for transport and, although the coking and gas industries can produce some 110 mill. gal. of motor spirit and other light hydrocarbon liquids annually, this is a very small part of the total requirement and the demand has led to projects which have liquid fuels as their main product.

The technique of chemical conversion has undergone striking improvements in efficiency since it was first introduced, but its possibilities are still very far from exhausted.

The Place of the Gas Industry

It would be absurd to pretend that the Gas Industry, or indeed any other branch of the fuel industries, consciously started its work or planned its development with the object of taking a definite and specified place in the national fuel economy. Each developed from small beginnings to meet a special need, and each has grown in size and achievement until now it is possible to assess the most profitable lines of future development.

The Gas Industry was established primarily for the purpose of making, distributing and selling gas rich in hydrocarbons as an illuminant, replacing the very inadequate earlier means of artificial illumination. Great though this boon must have been, it was so novel in character that it could never have reached any large degree of development unless the Gas Industry had undertaken also the supply of appliances for the utilization of the gas and maintained close contact with individual consumers. The early history of the Gas Industry has done much to mould the pattern of the Industry today. Essentially, it is a service provided for the individual small

user, in close contact with his needs and composed of units having a strong local interest. The degree of interest in the small user was greatly increased when, at the close of the last century, the prepayment meter was introduced and Gas Undertakings accepted responsibility for the provision of house piping, lighting fittings and cooking apparatus in the smallest households.

The introduction of a thermal unit basis of selling gas, in the Gas Regulation Act of 1920, was a recognition of the fact that the Gas Industry had accepted as its major function the supply of fuel for heating purposes, and today, while the greater part of the gas sold is used for domestic cooking, large quantities are supplied for water heating, room heating, for the heating of offices and other commercial purposes, and as a fuel for industry.

The properties of gaseous fuel enable the consumer to obtain the heat service he requires without the disabilities attached to the use of raw coal. He is released from the difficulties of storing and handling, precise regulation of the rate of supply of fuel and of combustion conditions is obtained, atmospheric pollution is avoided and there is no residue of ashes. This has meant the attainment of much higher efficiencies of utilization, a large saving of labour, increased service and convenience in performing the various tasks requiring heat, greater cleanliness and a substantial saving of transport. These advantages have been brought to the large industrial user and to the individual housewife alike.

Chemical conversion of coal to gaseous fuel is a process that can be carried out, theoretically, with the expenditure of a very small proportion of the total energy contained in the coal, though in practice it is necessary to expend a rather larger proportion than that theoretically required in order to obtain a reasonable speed in conversion and to avoid excessive capital charges. The actual thermal efficiencies obtained in normal working approximate to 80 per cent, though some large modern installations may approach 90 per cent. Normally, not all the potential energy is recovered in the form of gaseous fuel, a large part being obtained as potential energy in coke. Typical modern gas works practice would result in there being obtained from the 300 therms potentially available in a ton of coal:

	Potential Therms	Percentage on Coal
75 therms of gas	75	25
3 gal. of benzole	5	1·7
11 gal. of tar	20	6·7
10 cwt. of coke	140	46·6
	240	80·0

At the same time about one-third of the sulphur present in the coal is recovered in a form which can be used for the production of sulphuric acid, and part of the nitrogen present in the coal is recovered in the form of ammonia.

The proportions of gas and coke made can be varied within wide limits, and some of the gas supplied is produced by complete conversion of coal to gas. At the present stage of development there is still a very large demand for fuel in solid form and the fact that the Gas Industry can make coke available to the public has enabled part of this demand to be met by a smokeless fuel, capable of giving a higher efficiency in use than raw coal. Some 9 to 10 mill. tons of coke are produced annually by the Gas Industry alone: the coking industry, with coke as its main product, produces about 14 mill. tons, most of it for the iron and steel industry.

Benzole and tar may be regarded as liquid fuels, but in actual fact their uses are far wider.

Nearly 10 per cent of the total gas sold by the Gas Industry in 1938 was purchased from coke ovens. This is a development which took place almost entirely between 1921 and 1938 and has proved a valuable contribution to the national fuel economy by enabling good use to be made of gaseous fuel that is surplus to coke-oven requirements and was formerly wasted. It has enabled gas to be sold for industrial purposes on a very large scale and at a low price and is an excellent demonstration of the value of co-ordination between different branches of the fuel industry.

Viewing the Gas Industry as a whole it is seen to be an organization operating a highly efficient process for the chemical conversion of coal, distributing the gaseous fuel from that coal to the great majority of premises in the country and effecting personal contact with the users of fuel whether they be large or small.

This organization has been built up gradually over the past 130 years and has proved its value and adaptability under conditions of peace and war and under monopolistic and competitive trading conditions. Its creation and maintenance has not been achieved without cost, but the cost has been carried by gas consumers without the price of gas being any higher than its value to the user, as judged by the cost of using raw coal or other alternatives. A substantial proportion of the total price of gas represents payment for making the supply and service available, and the next task of the Gas Industry is to ensure that the service so established and maintained shall be used to such an extent that the consumer and the nation obtain the fullest value for the money and resources expended. Additional supplies of gas will be cheaper, as they will not have to bear the same overhead charges.

The advantages to the user, and to the community as a whole, of using gaseous fuel more extensively in place of solid fuel are very great. Technically, the change is quite practicable and, by developing, but not necessarily appreciably extending, the existing organization for gas distribution and service, the cost to the domestic user, at least, need be no higher than the present expenditure on fuel. Where solid fuel can be used efficiently it is likely to remain cheaper than gaseous fuel (unless other factors such as convenience have an over-riding importance) and for this purpose coke will remain available.

Coal Economy

Although it is necessarily a matter of estimation rather than exact measurement to show in figures the benefits that have been and could be derived from the replacement of solid fuel, a conservative estimate shows such large gains that the figures are worth quoting.

Rather more than half the total gas sold is used for domestic cooking in replacement of coal. The 750 mill. therms annually involved are doing the work formerly done by a quantity of not less than 25 mill. tons of coal, yet this gas is produced from only 10 mill. tons of coal and 5 mill. tons of coke is obtained at the same time. If the coke be regarded as necessary to supplement the heating of the house which no longer receives the waste heat from the coal cooker, the net saving of coal is 15 mill. tons a year.

Apart from the added convenience to the user, the benefits derived annually from this reduced use of raw coal may be estimated as:

Saving in coal	15,000,000 tons
Production of tar	110,000,000 gal.
,, benzole	30,000,000 gal.
,, sulphur	45,000 tons
,, ammonia	30,000 tons
Reduction in the quantity of coal delivered by road	20,000,000 tons
Reduction in ash disposal	2,000,000 tons
,, smoke emission	540,000 tons
,, SO_2 emission	800,000 tons

The cost to the consumer of doing his cooking in this way is not more, and is usually less, than the former expenditure on coal.

It cannot be claimed that the other half of the gas sold is effecting savings on quite so large a scale, because there are few appliances so inefficient in their use of coal as the coal cooking-range. Nevertheless, gas used for domestic water heating or space heating can replace coal with a consumption of 5 to 6 therms of gas for each cwt. replaced or 100 to 120 therms of gas to one ton of coal. Now as a ton of coal will yield 75 therms of gas (as well as 165 therms of coke, tar and benzole), 1·33 to 1·60 tons must be carbonized to yield this quantity of gas. The heat energy recovered in the secondary products is equal to that in 0·73 to 0·88 tons of coal, so the net consumption for the replacement of one ton of raw coal is 0·60 to 0·72 tons: a saving of 28 to 40 per cent.

Gas used for industrial purposes may or may not show a direct saving in net coal requirements: the uses are so various that generalization is impossible. The greater control obtainable with gaseous fuel does, however, at least compensate, and usually more than compensate, for the heat energy lost in the conversion of coal to gas.

We need to recognize that the Gas Industry is not alone in having contributed very substantially to the more efficient use of coal. The re-organization of the electricity supply industry between the end of the first great war and the present one led to very large savings in the coal required for power production. In 1917 it required on an average 3·7 lb. of coal to generate one unit of electricity. The 18th Report of

the Electricity Commissioners (1937-38) shows that only 1·42 lb. of coal was then required to do the same work. This increase in efficiency represented a saving of something like 17 mill. tons of coal a year. The achievements of the gas and electrical industries in their appropriate spheres represent a coal economy of great importance to the nation. The words "appropriate sphere" are important, for as I have shown on another occasion* the use of electricity in place of gas for the service that gas is already giving would be thermally so inefficient that it would go far to annul the savings already made.

Progress in Chemical Conversion

It has been stated that some 20 per cent of all the coal used in this country is subjected to chemical conversion to coke, gas or liquid fuels. Between 8 and 9 per cent is converted to electrical energy, leaving over 70 per cent still being used in the raw state. Improvements in the methods and appliances for the use of raw coal have been and will be made, but the inherent disadvantages of fuel in this form will remain. An increasing desire for convenience, cleanliness, precise control and general efficiency will lead towards more and more of the coal being converted to alternative forms before delivery and use. On the grounds of convenience alone electricity has the advantage that no combustion is involved by its use in consumers' appliances, but this advantage has to be weighed against the extravagant use of coal, the inability to store for peak demands and the high capital costs per unit of energy delivered. The balance will often fall in favour of the use of electrical energy (particularly is this the case for lighting), but for the majority of heating operations combustion possesses no disadvantage, and indeed, a flame is often desirable. Gaseous fuel can offer all the merits of convenience combined with economy in coal, low cost and the ability to provide for irregular demands.

Progress in the replacement of raw coal must, necessarily, be gradual and is most likely to be achieved by steady development of existing organizations. The Gas Industry regards the development of improved methods of domestic space-heating and hot-water supply as the most urgent need. Unnecessary work and dirt, coupled with atmospheric pollution, waste of coal and general inadequacy of the service provided, are the obvious faults of existing methods. Smokeless solid fuels are likely to be required by domestic consumers for some time to come, because custom has made solid fuels to appear necessary. For this reason much attention has been given to the preparation of coke and to the development of efficient appliances for its use. Coke, however, must be purchasable at a price not greatly in excess of that of coal if its use is to become general, and it can only be made available at such a price if the gas which is produced at the same time finds a ready market. Moreover, the preference for solid fuel is one based on custom, whereas the advantages of gaseous fuel arise from its intrinsic properties. Believing that the intrinsic properties of the fuel will eventually prove more decisive than custom, the Gas Industry is studying newer methods of effecting the chemical conversion of coal, aiming at the maximum production of those products, gaseous and liquid, which are likely to prove of the greatest value as fuels and chemical products in the future. To what extent these processes will be needed and at what point the coal should be converted—whether at the pit, or in the towns—remain problems for solution in the future. It does appear certain that the chemical conversion of coal holds possibilities at least as great as those already achieved by carbonization, and that the co-ordinated development of the Gas Industry along with other branches of the fuel industry is necessary to the national well-being.

Secondary Products

From the amount of coal that was burnt in the raw state in this country in 1939, there was produced one million tons of smoke from domestic chimneys and probably a further million tons from factory chimneys. From the same chimneys there went into the atmosphere more than 4 mill. tons of sulphur dioxide. Now, before the coal was burnt this smoke and the sulphur dioxide were potentially available as hydrocarbons and as sulphur. It is instructive to compare these statistics of atmospheric pollution by potentially valuable materials with the secondary products obtained by the gas and coking industries through the chemical processing of coal.

In the early days of the Gas Industry the secondary products—the by-products—tar and ammonia, were looked upon as unavoidable nuisances and were termed "residuals". Tar was disposed of by being burnt under retort settings and ammoniacal liquor was regarded as a waste effluent to be discarded in the least objectionable manner. Small quantities of tar were distilled for the preparation of solvents and some was used in its crude state as a paint for the protection of structures from the weather. The first distillation on an appreciable scale came with the discovery of the value of creosote as a preservative for timber, particularly railway sleepers. Real interest in coal tar as a source of organic raw material for industry was aroused by the discovery of synthetic dyestuffs between 1856 and 1872 and tar was then distilled for the recovery of benzene, toluene, naphthalene and anthracene. With the advance of chemical knowledge further compounds of interest were identified and separated, and not for dyestuffs alone. Disinfectants, drugs, photographic developers and, later, plastics, derived their basic chemical structure from the aromatic hydrocarbons and derivatives in coal tar. But at no time has the quantity of these products recovered represented more than a small proportion of the total tar made. When the synthetic chemical industry was first taking an interest in the hydrocarbons of coal tar, the annual production of tar was less than 500,000 tons annually. By the beginning of this century it had reached 1,000,000 tons and at the outbreak of the present war production was doubled again through the adoption by the coking industry of by-product recovery ovens.

The coming of the motor car, in the early days of this century, showed the need for greatly improved methods of road surfacing and coal tar found a new use. At first the idea was no more than the provision of a binder that would not dry out in hot weather, as water does, giving a dusty surface, and would not allow the road surface to revert to mud in wet weather. Progressive increase in the volume and weight of traffic and in its powers of acceleration and braking has made the preparation of tar-bound road surfaces a matter requiring scientific understanding and control. These demands have been met and road surfacing today is a highly skilled branch of technology that requires binders very different in properties from the crude tar which is their origin.

Rather less than half the total tar produced in the country was, before the war, used for road surfacing. The remainder was distilled for the production of creosote and pitch. Creosote found useful application as a wood preservative at home and abroad, and a large quantity was supplied as a raw material for hydrogenation to motor spirit. Pitch was used for briquetting small coal into lump fuel for domestic and industrial purposes, but this is a development that has found more favour on the Continent than in this country, and about half the pitch produced was exported, mainly to France and Belgium.

In 1939 the national production of tar was accounted for approximately as follows:

Production, tons		Usage, tons	
From Gas Works ...	1,000,000	As road tar	750,000
From coke ovens ...	1,000,000	Creosote hydrogenated ...	210,000
		Creosote used at home ...	145,000
		Creosote exported ...	95,000
		Pitch used at home ...	400,000
		Pitch exported	350,000
		Sundry uses	50,000
Total	2,000,000	Total	2,000,000

A product allied to tar, but mainly recovered from the gas, is crude benzole. In peace-time the chief value of benzole is as a motor fuel of high anti-knock properties, though it is also a source, in such quantities as the chemical industry may require, of benzene, toluene and xylene. In war-time its value as a source of toluene is of the greatest importance. In 1936 about 210,000 tons of crude benzole was provided by the coking industry and 110,000 tons by the Gas Industry, but it is known that the output has been largely increased and will be increased to the practical maximum. The probable destination of this material would in peace-time be about

*J. Soc. Arts, 1938, lxxxvi, 530.

90 per cent to motor fuel and 10 per cent to chemical industry.

Under war conditions road maintenance is not carried out to the same extent as in normal times, though the materials used and experience acquired in road construction have been applied to aerodromes. The export markets for pitch and creosote are closed for the time being and tar is now being used to replace fuel oil formerly imported and thus ease the strain on fuel supplies.

Ammonia, second in importance to tar as one of the products of coal carbonization, found no useful application until 1875-1880 when the importance of fixed nitrogen as a plant food was recognized. Development of the ammonia-soda process and other branches of chemical industry, the demand for sal-ammoniac for Leclanché cells and the use of ammonia for refrigerating plants made heavy demands upon the supplies of by-product ammonia until after the war of 1914-18. During that war it was realized how enormous are the demands for fixed nitrogen in the manufacture of the explosives required for a major war and it was necessary to supplement the resources available from by-product ammonia by the erection of ammonia synthesis plants. Broadly, it may be said that the 260,000 tons of ammonium sulphate available annually from the carbonizing industries is sufficient for the peace-time requirements of this country for nitrogenous fertilizers and chemical industry. The synthetic ammonia industry represents an indispensable war reserve. Although the advent of the latter at first made it difficult for by-product ammonia to find a market in times of peace, marketing arrangements between the two sources of supply have enabled both to contribute to peace-time needs at home and abroad.

Chemical industry, before this war, required about 350,000 tons of sulphur annually for the production of sulphuric acid. The greater part of this sulphur was imported as sulphur or pyrites, but the Gas Industry recovered from the gas it supplied some 100,000 tons of sulphur—95,000 tons being used for sulphuric acid manufacture and about 5,000 tons being exported.

The carbonizing industries have not, as a rule, undertaken the synthesis of fine chemicals from their secondary products. Where preparation for the consumer is a simple operation and can be conducted on a large scale, this has been done, e.g., in the case of sulphate of ammonia, but the production of fine chemicals is a highly-specialized industry both in manufacture and sales, and its scale of operations is so different from that of coal carbonization that the carbonizing industries have hitherto preferred to sell their products in crude or semi-refined form.

In recent years the trend of chemical industry throughout the world has been in the direction of converting raw materials to a simple chemical form and synthesizing from these simple forms the products required. By so doing a better control can be exercised over the quality and variety of products. There are indications both in this country and abroad that fuel processing may follow similar lines and that instead of obtaining a tar which contains many complex bodies from which the desired chemical raw materials can be separated, there will be a tendency to produce compounds of simpler molecular structure, such as hydrogen, carbon monoxide, methane, ethylene and the lighter liquid hydrocarbons. The possibilities of development on these lines are very great and the Gas Industry is well placed to adapt them in such directions as the national requirements shall indicate.

The Gas Industry in Relation to the Small Consumer

I have said that the service given by the Gas Industry is essentially a service provided for the individual small user. Just before the outbreak of the present war there were 7¼ mill. prepayment consumers of gas, in addition to 4 mill. ordinary consumers, 3¼ mill. prepayment consumers having been added since 1920. During the period between the two wars the length of mains in Great Britain increased from 38,000 to 65,500 miles. These statistics show that a supply of gas had been made available to the great majority, probably nearly 90 per cent of all premises in the country, but the Gas Industry has never been content merely to lay the service pipes to the consumer's house and leave him to make the best use he can of the fuel so supplied. The ordinary user of fuel, whether in the home, factory or commercial premises, has very little knowledge of the technique of fuel utilization, nor is it to be expected that, left to his own devices, he could obtain anything like the satisfactory fuel service that modern knowledge makes possible.

These facts have led the Gas Industry to develop to a high degree that branch of its work which is termed "Consumer Service". It involves a study of consumers' needs, with research and development work to ascertain how these needs may best be met. For the design and supply of appliances to meet these needs it requires that there shall be trained staff available to advise on the choice of appliances, to fit and service them. Even further, the development of schemes for home service, operated by women trained in domestic science, showed how necessary it was to make personal contact with housewives in their own homes to ensure that they obtained the best results with the equipment made available to them. In all this there has been built up an advisory and educative service of immense value. However much we may desire to see the resources of science applied rationally in everyday life, this will never be brought about amongst a free people by decree or regulation. It can only be done by guidance, through advice, educative propaganda, demonstration and skilled service. This is the task of the outdoor staffs of the Gas Undertakings, and, with this interpretation, salesmanship can be made a real social service.

In this connexion we need to understand why it is that a refined fuel such as gas is able to do so much to improve conditions in the home and in the factory. Primarily it arises from the complete control or flexibility which enables it to be applied with precision to do a specific task as and when required. From this basic advantage arise the convenience, cleanliness and economy which we are able to provide, but if these advantages are to be realized in practice it means that the service must be available at all times to meet the consumers' wishes.

Costs

Gas itself is essentially a cheap fuel. The majority of Gas Undertakings before the war produced gas into holder at a figure of 2d. to 2½d. a therm, exclusive of overhead charges. One may well ask—"Why was the consumer charged 8d. to 10d. a therm?" Now it costs something like £10 to £12 simply to connect the ordinary domestic consumer to the network of mains. The provision of "consumer service" in the form of district staff, showrooms, service depots, appliance repair facilities, the collection of accounts and the management of the Undertakings make up a total which represented about 50s. per consumer per annum. Further, it is necessary to provide capital both for works plant and for the distribution network. Of these three groups of items the costs proportional to the number of consumers comprised some 60 per cent of the total selling price, the balance being made up approximately by 20 per cent for works and distribution capital and 20 per cent actual gas cost. It is clear that if the consumer is to realize the greatest benefit for the money he pays, the fullest possible use must be made of the expenditure on consumer service and invested capital. The two factors which determine the incidence of overhead charges on the price per therm are the consumption per consumer and the load factor. The consumption per domestic consumer throughout Great Britain was about 85 therms per annum, and this is far too low for him to obtain the full benefit of the consumer costs which he pays. The position with regard to load factor was much happier.

In discussing the question of load factor we need to differentiate between the load factor on the manufacturing plant and that on the distribution system. So far as manufacturing plant is concerned, hourly variations in demand are of little significance because of our ability to store gas and thus to keep the manufacturing plant in steady operation for 24 hr. a day. The variation that is of consequence on the manufacturing side is the seasonal variation, and for most Undertakings the existing load factor is between 60 and 70 per cent, that is to say, the total annual production of gas is equal to 60 to 70 per cent of that which would be produced if the plant operated at full load throughout the year. On the other hand, our distribution load factor is a bad one. The majority of Gas Undertakings distribute through their mains network 20 per cent or less of the quantity that could be distributed if the mains were operated at full load continuously. The domestic load consists mainly of the demand for cooking

and represents a load factor of only some 15 per cent. The fact that a distribution system for gas can be operated at such a poor load factor without incurring excessive costs is evidence of the economy of distributing fuel in this form. Whatever additional loads are obtained in the future they can hardly do other than improve the present distribution load factor, although they are likely to lower somewhat the manufacturing load factor.

Now it is instructive to compare this broad analysis of the cost of gas supply with the costs of supplying an equivalent quantity of heat electrically. If we make the basis of comparison the supply of 50 useful therms per annum, (i.e., 100 therms of gas or 2,000 units of electricity), the price paid by the consumer for electricity will be made up of about 15 per cent for the electricity itself, about 25 per cent for consumer costs and 60 per cent for the capital investment in generation and distribution plant. It is evident from these figures alone that cheap electricity demands above everything else a good load factor. The absence of any means of storing electricity makes the improvement of load factor far more difficult to achieve, and both generation and distribution load factors have to be considered on an hourly basis (which, of course, being based on 8,760 hr. per annum, includes the seasonal variation) and not daily as in the case of gas. Increased consumption of electricity per consumer by virtue of a wider spread of the consumer costs will tend towards lower total costs per unit, but not nearly so surely as will improvement in load factor. Indeed, it may be said that an increased consumption per consumer, for such purposes as cooking, will so reduce the load factor that the average cost of supply must increase materially.

This fundamental difference in the economics of supply of the two services may be shown graphically by plotting the cost of a useful therm (and the price per therm of gas or per unit of electricity) against the appropriate load factor; hourly for electricity and daily for gas. In the two graphs which form Figure 1 this has been done and the normal range of existing load factors is shaded to show more clearly the essentially different nature of the problems with which the two industries are faced in endeavouring to supply their commodities at minimum cost.

A study of this diagram will show that a consumer taking 50 useful therms per annum (approximately equal to the cooking load) would consume electricity costing 1·6d. per kWh if the load factor were 20 per cent, whereas with a load factor of 40 per cent the economic price would be just over 1d. per kWh. On the other hand, for this quantity of useful heat a Gas Undertaking operating with its load factor between 50 and 70 per cent would be able to supply at about one-half the equivalent price, namely 0·5d. per kWh. It is seen also that the reduction in cost of electricity by improving the load factor from 20 per cent to 40 per cent is about twice as great as the reduction to be obtained from a six-fold increase in consumption per consumer. In contrast to this, the improvement of the gas load factor even to 100 per cent would not show any great reduction in cost but an increase in consumption per consumer from 50 useful therms to 300 useful therms per annum would halve the cost per therm.

Surely, this contrast in economic factors arising from physical differences should form a sound basis for co-operation between the two great industries. It is the duty of both to improve fuel utilization, giving the best possible service to the consumer at the least possible cost. Uninstructed competition between the two on the lines that were not uncommon in pre-war years could easily lead to the cost of both services becoming excessive. If a load of poor hourly load factor, such as the cooking load which is now supplied by gas, were transferred to electricity the price of gas would rise on account of the fall in consumption per consumer. At the same time the price of electricity would rise owing to the costliness of a load of such intermittent nature and both industries would have moved retrogressively. Co-operation between the two could lead to improved load factors for electricity with increased consumption per consumer while still permitting the Gas Industry to reduce its costs by an increased consumption per consumer.

The gas and electrical industries have each a case to state, and it will be necessary at the appropriate time for these cases to be submitted to the impartial judgment of an authority charged with the responsibility of seeing that complementary development takes place in the best interests of the public.

Methods of Charge

The practical realization of co-operation on an economic basis will not be brought about unless the methods of charging for gas and electricity are designed so as to reflect the economic cost of supply. Naturally, the terms as presented to the public must be attractive and simple. A pedantic in-

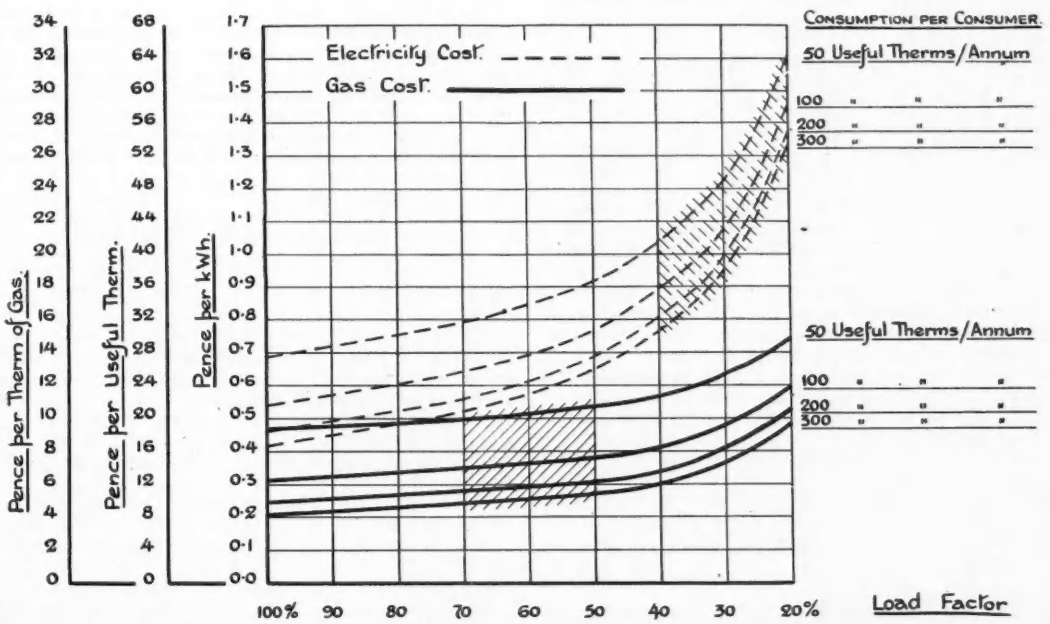

Figure 1.—*Comparison of Effect of Load Factor and Consumption per Consumer on Gas and Electricity Costs.*

The two sets of curves show the effect upon cost per therm or per kWh of variations in load factor. Each set consists of four curves representing annual consumptions of gas or electricity per consumer of 50, 100, 200 and 300 useful therms. The useful therms are calculated assuming an average utilization efficiency of 50 per cent for gas and 75 per cent for electricity (at which 20 kWh are equivalent in use to 1 therm of gas), and the price figures on the three scales are thus made directly comparable. Two shaded areas, covering portions of the two sets of curves, indicate the range of load factors and consumptions likely to be experienced in supplying the two commodities for domestic requirements.

sistence upon the strict equality of cost and payment for each portion of the load is not practicable. There must, however, be no offer made which could not be fulfilled if the public response led to its development to the limit. For example, a two-part tariff consisting of a fixed charge and a commodity price may be offered. Then, the two-part tariff must be economic even though all consumers were to meet their entire needs by the use of the commodity at the terms quoted. It is extremely doubtful whether many electrical pre-war tariffs could have stood this test.

A satisfactory system of charge, capable of leading to progressive development, must do more than ensure an adequate return to the Gas Undertaking for the expenditure incurred. It must also be attractive to the consumer. Now, the purposes for which gas may be used in the home are several and the value of gas in substitution for coal is not the same for every purpose. If the gas is used for cooking, its value in relation to coal is high and a therm of gas used for this purpose may be worth the price of ½ cwt. of coal. It is, therefore, to the cooking load that we must look for recovery of at least the greater part of our consumer costs. The margin between the bare cost of manufacture and the price at which gas can be sold for cooking may be 6d. or more per therm. If we regard the quantity of gas needed for cooking as amounting to 80 therms per annum, there is obtainable an annual sum of 40s. to 50s. to cover the overhead costs of supply. While this sum is usually sufficient for the limited gaseous fuel service represented by cooking alone, it may not be enough to cover the overhead costs associated with a complete service of gaseous fuel for all domestic purposes.

From the point of view of the Undertaking it would be reasonable to ask a consumer who wished to extend his use of gas to pay, as a fixed annual charge, the estimated overhead costs of a complete service. This would not look so reasonable to the consumer, because the fixed annual charge might well be greater than his present gas bill. The alternative would seem to be the adoption of a lower fixed charge and a higher commodity or "running" charge. Even this has its difficulties, because for a large part of the domestic fuel requirements—the living-room heating load—six therms of gas are needed to replace 1 cwt. of coal. The value of a therm of gas is, therefore, the price of ⅛ cwt. of coal and gas must be obtainable at about this price if it is to be used extensively for heating the living room. Such a value for gas does not show much margin over the cost of manufacture, and it might seem that, as we cannot obtain either a high commodity price or a sufficiently high fixed charge, the problem is insoluble.

The difficulty can be resolved by making use of the fact that there is a group of purposes for which gas is worth more than it is for living-room heating though less than it is worth for cooking. For occasional space heating, water heating in the summer time or meeting intermittent demands for hot water, for the wash boiler and the refrigerator, gas is worth per therm at least the price of ¼ cwt. of coal. Now, the value of gas to the user for these purposes is distinctly greater than its cost of manufacture and supply. Therefore, by developing this class of business, at a somewhat lower price than that charged for gas used in cooking, there can be recovered a sufficient margin of revenue to cover the overhead costs of supplying the complete domestic service which uses gas for all heating purposes. The fixed annual charge then need be no more than that appropriate to the cooking load and, in consequence, of interest to the majority of consumers.

These remarks cannot anticipate future development in appliances for the use of either gas or coal but give an indication of the type of price structure that would reflect the value of gas in relation to coal. Further it shows the way in which consumer costs may be recovered on those therms which show the greatest advantage to the consumer due to the flexibility of gas. It also emphasizes the importance of retaining and developing those loads of highest value preparatory to accepting new loads for which gas must be valued at a lower price per therm.

Solid Fuel

It will be apparent that development in the use of gaseous fuel must take place very largely at the expense of raw coal which is at present used so extensively. Some increase in demand there will be, due to the desire for a more adequate supply, particularly for domestic hot water, but in the main development in improved fuel service must mean the replacement of raw coal by gas and electricity.

The coal industry will point out, however, that the most remunerative market for coal is and has been the domestic market and that if this market disappears the price of coal to other users must increase. Undoubtedly this situation must be faced and if, as has been stated, the 40 mill. tons of coal supplied to domestic users show a return of 4s. a ton more at the pithead, then coal sold to industry and to the gas and electrical undertakings will need to make good the deficit due to the loss of the domestic market. This annual sum of £8,000,000 must be spread more evenly over the total home consumption of 180 mill. tons. It would mean an all-round increase to coal consumers, other than domestic, of a little more than 10½d. a ton (representing an increase in the commodity price of gas of 0·07d. a therm), a price that would surely be worth paying for the benefits that the community as a whole would receive. What would be unwarrantable would be any attempt to impede the progress of development of the refined fuels by compelling public utilities to pay so much more for their coal that they were forced, in effect, to subsidize the domestic raw coal market.

Now, in all our considerations of the future development of refined fuels, we must remember that the public will not change their habits quickly. Raw coal is used very largely, and at present supplies the greater part of domestic heat requirements. The replacement of solid fuel will be slow and we should be foolish to expect any wholesale change from solid fuel towards the use of gas and electricity. At the same time we can ensure that so long as the public wishes to use solid fuel it can do so without the grosser disadvantages attached to its use. In so doing coke will prove a valuable ally to gas. Once again, we must see that we employ coke in such a way that its use will be most beneficial to the public and that we do not advocate its use solely because we happen to have it available. The intrinsic advantages of solid fuels in comparison with gas and electricity are their ability to be stored near the point where they will be required for use, and their low cost per therm of potential heat. These facts indicate that the most profitable use of coke will be made when it is used to meet the heavy winter demands, where low cost and the avoidance of seasonal peaks on manufacturing plant are more important than flexibility of control. At the present stage of technical development in manufacture, it may well be our responsibility to see that domestic fuel systems are developed and introduced so that the properties of coke may be employed to relieve the winter peak demands for gas and thus give a complete fuel service having the greatest advantages at the lowest overall cost. During the warmer months, gas water-heating proves cheaper as well as more convenient for the normal demands made in the average home. In winter, the use of coke for water heating gives the advantage of general warmth throughout the house; an advantage which can be augmented if radiators are placed in the return circuit.

The Development of Fuel Supply

As a result of examining the technical and economic bases of the production and supply of gas in relation to the fuel economy of the country as a whole, we become more than ever convinced of the soundness of the foundations of the Gas Industry. If such an understanding did no more than induce in us a feeling of relief and complacency, it were better that no such examination had been made. The past achievements of our Industry are no guarantee of future success, though the tradition of unfailing public service will be a background to our endeavours in making the greater contribution that the times demand.

Our reaction to the knowledge that our services, both actual and potential, are really needed by the nation must surely be a keen desire to discharge our responsibilities fittingly. Of the interesting nature of the work, of its social value and its economic value there can no longer be doubt.

It is not given to us to see the future in any detail and attempts to force development into a pattern of our own imagining are apt to be futile. We cannot predict the cost of operating processes yet to be developed, nor can we assume any coercion of the public to increase their use of our services, even though it may be in their own best interests

so to do. What we can do is to know the potentialities of existing methods of processing and distribution, and the needs of the public, and with this knowledge to decide the general line of development likely to bring the greatest benefit to the individual and to the community. With these defined, our aims are clear and whether we are speaking amongst ourselves as servants of this great Industry, to the public, or to representatives of local authorities, or to the Government, we can be specific as to the nature and extent of the contribution we are offering.

A knowledge of the general direction in which we wish to move will enable us to foresee likely obstacles and to take steps for their removal before they hinder progress. Co-operation with the coal and electrical industries will be facilitated because we shall understand better the part that we should play, and the functions that can best be fulfilled by those with whom we are co-operating. Development has been slower than it might have been, largely because neither the public nor those that represent the public in the Government of the country have recognized the full potentialities of gas as a means of overcoming the disadvantages which we all know to be associated with the use of raw coal. Indeed, if civic authorities did recognize our potential value to their community, there could not fail to be insistent demands that we should speed up our evolution.

It is instructive, and not without interest, to compute for our own guidance, as well as for that of others, the advantages that we could bring to a town in which our services were utilized more fully than is customary today. If I were to take an actual town and describe the possible line of development there, I should be presuming to know more about the affairs of that town than those who are already controlling its destinies. To avoid such presumption it is better to consider the case of an entirely imaginary community whose requirements of fuel are typical of the average throughout the country. This township may be regarded as moderate in size with a population of, say, 200,000 people forming 50,000 families. It would have a normal proportion of industrial premises, commercial buildings and residential quarters. It is not a city of the future, the plans of which we have not yet seen, but a fair sample of things as they are with a Gas Undertaking and an Electrical Undertaking already in existence, but with coal being burnt in the raw state for the greater part of its fuel requirements. It must be assumed that the public utility undertakings are efficient according to modern standards, but that the desire for improvement has been recognized and the various interests are prepared to work together.

Since it is impossible to forecast the level of prices after the war we must work with pre-war figures, remembering that, while the actual figures may change, their relative magnitude is likely to remain. As our town is representative and not specific, it will be neither particularly close to nor far from the coal-fields, and we may assume that coal is delivered to the town in bulk for 25s. per ton. The domestic consumer would pay 45s. a ton for his coal. Coke would be sold in the domestic market for 44s. a ton, while the net revenue to the Gas Undertaking can be taken at 24s. a ton. Tar might be expected to be worth 2½d. a gallon and crude benzole 1s. 1d. a gallon. The yields obtained at the Gas Works from a ton of coal would be 75 therms of gas, 10 cwt. of coke, 10 gal. of tar, 3 gal. of benzole, 10 lb. sulphur and 7 lb. ammonia (NH_3). Much of the capital assets of the Gas Undertaking would have been acquired at a time when they cost less than the prices current in 1930-38, but extension or replacement would have to be provided at the ruling prices. Figures appropriate to the pre-war period have therefore been used, the source of the information being the experience of Undertakings that carried out extensive replacements or reconstruction during that time. In estimating the cost of providing a gas supply, manufacturing capital has been allowed at 13 per cent per annum, that is, 5 per cent interest, 5 per cent on maintenance and 3 per cent on sinking fund, this latter allowing for renewal or amortization in 20 years. On distribution capital 10 per cent per annum has been allowed, made up of 5 per cent interest, 2 per cent maintenance and 3 per cent sinking fund. No allowance has been made for consumer's appliances, either in the capital required or in the working cost, because it is assumed that business in appliances should be self-supporting. Any deficit that might be incurred would be regarded as a part of the consumer service. It is essential to the argument that the Gas Undertaking should be regarded as a live one, giving excellent consumer service and for this an allowance of 20s. per consumer per annum is made. The costs of electricity supply are deduced from the returns of the Electricity Commissioners.

Development of fuel supply in our town is considered in four stages. At the first stage the position is broadly typical of pre-war conditions throughout the country. The consumption of gas per domestic consumer is 100 therms per annum. The use of electricity is on a more generous scale than the actual pre-war position, an allowance of 680 units for each domestic consumer being assumed. The balance of the domestic fuel is mainly coal, though a little coke is used. The Gas Undertaking experiences a seasonal load factor of 60 per cent, while the electricity load factor is 33 per cent.

In tracing development from this point most attention has been given to the domestic consumer and full value has not been given to possibilities of expansion in the industrial and commercial premises. This is intentional, because we want to see the effect of developing primarily on these lines.

At the second stage of development considerable progress has been made in the use of gas for water heating in the summer months, and for such other loads (e.g., space heating in spring and autumn and refrigeration) as would tend to improve the seasonal load factor of the Gas Undertaking. The use of coke has been developed to some extent to replace coal as a solid fuel. At this stage no assumption has been made as to the results of co-operation between the gas and electrical undertakings to improve the electrical load factor, and annual consumption of electricity is not taken as being any higher than in the first stage (where it represents about double the actual use throughout the country in 1938). The consumption of gas per domestic consumer has increased to 210 therms per annum. Now, this could not have happened without modification of the method of charging for gas. At stage I the charge for gas was a flat rate of 10·4d. a therm, but to reach stage II a type of tariff has been envisaged incorporating a fixed charge which for the ordinary dwelling would be 40s. per annum, and would entitle the user to a supply of gas at 6d. a therm for the first 300 therms and 4d. a therm thereafter. This is a type of tariff intended to represent the value to the consumer of a continuously extending service, while remaining—on a pre-war basis of computation—economic to the Gas Undertaking at all stages of development.

Stage III represents the state of affairs when the use of gas has been extended to cover most of the water-heating and occasional space-heating loads. The seasonal incidence of this latter has caused the Gas Undertaking load factor to fall from the 70 per cent that was reached in stage II to 60 per cent, but, of course, with an increased output. Coke is assumed to have replaced coal entirely for space heating and for some water heating. At this stage of partial development in the use of gas for domestic heating, it is better that the available coke should be used for the balance of domestic fuel requirements, as its effect in reducing smoke emission is greater when used in this manner than when used industrially. Co-operation between the fuel utility undertakings has led to better balancing of the electrical load factor by using off-peak current for water heating. The annual consumption of electricity has increased to 1,040 units per domestic consumer without any increase in generation or distribution plant. This represents an electrical load factor of 50 per cent and permits a fall in the average price of electricity from 0·982d. per unit to 0·706d. per unit, a measure of improvement which probably represents the practical limit of load balancing.

At stage IV the gas supply has developed to the point at which 50 per cent of all domestic consumers have dispensed entirely with solid fuel and use gas exclusively for heating, while the other half continue to use gas and coke as they did in stage III. This development has resulted in an increase in gas consumption to 424 therms per consumer per annum but the load is obviously more seasonal and the Gas Undertaking load factor has consequently fallen to 54 per cent.

Detailed figures of the use of fuel, the measurable advantages obtained, and the financial aspect of the changes made at each stage are given in Tables 1 and 2. It is impossible to express either numerically or graphically the greater convenience in running the homes of this town, or to evaluate the improvement in the conditions of living, the greater clean-

TABLE 1.—*Development of Fuel Supply, Stages I-IV: Use of Fuel and Measurable Advantages Obtained*

	Stage I	Stage II	Stage III	Stage IV
Allocation of 300 useful therms per domestic consumer :				
Gas	50	105	150	212
Electricity	17	17	26	26
Coke	8	28	124	62
Coal	225	150	—	—
Load factor on utility undertakings, per cent :				
Seasonal load factor for gas	60	70	60	54
Hourly load factor for electricity	33	33	50	50
Total fuel used per annum :				
Domestic—Coal, tons ...	225,000	150,000	Nil	Nil
Coke, tons ...	5,500	20,000	90,000	45,000
Gas, therms ...	5×10^6	$10{\cdot}5\times10^6$	15×10^6	$21{\cdot}2\times10^6$
Electricity, kWh	34×10^6	34×10^6	52×10^6	52×10^6
Industrial—Coal, tons ...	224,400	201,900	228,600	138,600
Coke, tons ...	30,800	53,300	20,000	108,000
Gas, therms ...	$0{\cdot}5\times10^6$	$0{\cdot}5\times10^6$	$1{\cdot}5\times10^6$	$1{\cdot}8\times10^6$
Electricity, kWh	68×10^6	68×10^6	68×10^6	68×10^6
Total coal required :				
For use as such, tons ...	449,400	351,900	228,600	138,600
For gas and coke production, tons	73,700	146,700	220,000	306,000
For electricity production, tons	62,100	62,100	73,100	73,100
Total, tons	585,200	560,700	521,700	517,700
Products recoverable :				
Tar, gal.	737,000	1,467,000	2,200,000	3,060,000
Benzole, gal.	221,000	440,000	660,000	918,000
Sulphur, tons	330	660	880	1,360
Ammonia, tons	230	460	690	960
Local amenities :				
Smoke pollution of atmosphere (domestic), tons ...	6,100	4,050	Nil	Nil
Smoke pollution of atmosphere (industrial), tons ...	2,240	2,020	2,286	1,386
SO_2 pollution of atmosphere (domestic), tons	9,170	6,300	2,700	1,350
SO_2 pollution of atmosphere (industrial), tons	12,820	13,030	13,984	10,294
Total Annual Pollution, tons	30,330	25,400	18,970	13,030
Solid fuel transported through streets for retail delivery, tons	230,500	170,000	90,000	45,000
Ash removal from domestic premises, tons	23,000	17,000	9,000	4,500
Probable distribution of consumption per consumer, therms per annum :				
Consumers taking below 100	30,000	10,000	5,500	3,500
100 to 200	17,750	20,000	7,500	5,000
200 „ 300	2,000	14,000	12,000	7,500
300 „ 400	200	4,000	15,500	8,000
400 „ 500	50	1,850	5,500	12,000
above 500	—	150	4,000	14,000

liness and the effects of a purer atmosphere. Those items that can be measured show what immense progress is possible. Although the town as a whole consumes in stage IV nearly 70,000 tons of coal less per annum than in stage I, the amount of secondary products available for use in the town, or for sale outside, has increased four-fold. Atmospheric pollution by smoke has been reduced to a point at which it is no longer a serious nuisance. Sulphur-dioxide emission is confined mainly to industrial premises where the problem can be tackled by treatment of waste gases. Transport problems of solid fuel and the costs of ash removal are both eased to the point at which they no longer hamper the life of the town. The capital investment in fuel utility services has increased by nearly £8 per head of population, but the fuel bill of the average domestic consumer shows a substantial reduction. Both gas and electricity show an increase in use to three or four times the normal pre-war figure and the price of each has been reduced 30 to 40 per cent. It is clear that within such a general scheme of development a great deal of liberty is allowed to the individual consumer in selecting methods of fuel usage which accord with his particular taste. At each stage in the development the scheme is economic and there is no necessity either to hesitate over commencing the expansion because the ultimate result is doubtful, or to insist upon progress being speeded-up artificially in order to reach an economic position within a limited term of years. Surely, such a scheme is likely to appeal far more to those who wish to see the practice of fuel utilization improved by public enlightenment than the much-discussed schemes of district heating which require a high degree of standardization in the equipment of homes and the habits of the people.

In this attempt to depict numerically the progress of coal-processing along lines already known to us, no radical changes in technique have been presumed. Little attention has been given to the full development of the use of gas in commercial and industrial buildings, though the scope for bringing the advantages of gaseous fuel to the workplace as well as to the home is great and still much under-developed. The reasons for giving so much attention to the domestic consumer are that this class of consumer already provides the greater part of the demand for gas, that the need for improvement is greatest in the homes, and that progress is likely to be slowest in that field which directly affects the lives and customs of millions of people.

PLANNING AHEAD

Now having seen, both from a study of basic principles and by reference to one example worked out in some detail, the general lines of development open to our Industry, we have next to consider the principles to be adopted if we are to attain this end. At this point we enter the somewhat unpopular realm of planning.

I wonder how much of the criticism of planning arises from confusion between a plan and a blue print. To assume that it is possible for any small body of men to get together and draw up detailed instructions for the thought and behaviour of large numbers of ordinary people is ridiculous. It is just that absurd and dangerous notion which the civilised world is fighting against. Every one of those ordinary people has individual ideas, preferences and characterstics and each can make some contribution of value to the common good. The sole object of planning is to ensure that the individual contributions are directed into a common channel, thus leading to orderly progress and avoiding, so far as is humanly possible, the chaos of conflicting views which results in the frustration of individual effort.

Thus, while the Gas Industry can plan to develop its public service along lines similar to those suggested in this Address, it cannot ever lay down detailed plans to take the place of individual initiative, and should not attempt to do so. The plan itself can be built up only by taking into account the ideas and experience of individuals and deriving from these the greatest common measure of agreement. This is the first task, and it can be said that appreciable progress in this direction has been made. When it is found that certain ideas have a substantial measure of support and certain lines of develcpment are agreeable to the majority, then these ideas or lines of development can be pursued and that means that they need to be defined.

We shall find it necessary to state in definite terms what we consider, as an Industry, to be a satisfactory gas service. The definition must take into account the efficiency with which coal is treated at the Works and the cost of carrying out this treatment. Due weight must be given to the quality of the products, to the uniformity of supply and to the adequacy of consumer service. Now, it is impossible to create standards arbitrarily without reference to conditions as they already exist. The only rational procedure is to ascertain the best existing practice in these several respects, and to assist the Industry as a whole to bring the general level up to that of the best. The nature of the assistance required will be different in different instances and the obvious first step is to define good modern practice. It may then be found that, for one reason or another, some Undertakings are not able to achieve this standard. Perhaps their resources are too small, or there are local difficulties to be faced. Under the pressure of war conditions notable advances in mutual help have been made and it is inconceivable that these advantages will be thrown away when peace returns. It is far more likely that the principles so established will be utilized in greater degree to meet the developments required from us in the future. The situation must be met by assistance to those in need of it from the Industry as a whole and this assistance may well develop into regional or other forms of control.

Some of the standards which we shall have to regard as the criteria of good gas service have been defined in the Reports of the Committees of Enquiry set up by The Institution of Gas Engineers. The necessity of accepting these standards voluntarily, and then complying faithfully with them, may be illustrated by reference to the matter of sulphur removal.

It is a fact that there is no more convenient, efficient or

TABLE 2.—*Development of Fuel Supply, Stages I-IV: Financial Aspect*

	Stage I	Stage II	Stage III	Stage IV
	£	£	£	£
Capital required for fuel utility services :				
Gas manufacture	314,000	540,000	941,000	1,460,000
Gas distribution	667,850	752,350	902,350	1,095,350
Total for gas	981,850	1,292,350	1,843,350	2,555,350
Electricity generation	620,000	620,000	620,000	620,000
Electricity distribution	1,560,000	1,560,000	1,560,000	1,560,000
Total for electricity	2,180,000	2,180,000	2,180,000	2,180,000
Total for fuel services	3,161,850	3,472,350	4,023,350	4,735,350
Investment *per capita*	15·81	17·36	20·16	23·68

Fuel bill of average domestic consumer :		Cost		Cost		Cost		Cost
		£ s. d.		£ s. d.		£ s. d.		£ s. d.
Coal, tons	4.5	10 2 6	3·0	6 15 0	—	—	—	—
Coke, tons	0.11	0 4 10	0·4	0 17 7	1·8	3 19 2	0·9	1 19 7
Gas, therms	100	4 6 8	210	6 18 3	300	8 14 10	424	10 19 4
Electricity, kWh	680	2 15 7	680	2 15 7	1,040	3 1 3	1,040	3 1 3
Total cost		17 9 7		17 6 5		15 15 3		16 0 2
Average selling price of gas and electricity :								
Gas, pence per therm		10·4		7·90		7·00		6·22
Electricity, pence per kWh		0·982		0·982		0·706		0·706

TABLE 2.—*Development of Fuel Supply, Stages I–IV: Financial Aspect—(Contd.)*

	Stage I		Stage II		Stage III		Stage IV	
	£	Pence per therm	£	Pence per therm	£	Pence per therm	£	Pence per therm
Expenditure of Gas Undertaking :								
Capital Charges—Manufacture, at 13 per cent	40,800	1·78	70,200	1·53	122,000	1·77	190,000	1·98
Distribution, at 10 per cent	66,790	2·92	75,240	1·64	90,235	1·31	109,500	1·14
Consumer Service, at 20s. per consumer	50,000	2·18	50,000	1·09	50,000	0·73	50,000	0·52
Management, etc., at 12s. per consumer	30,000	1·31	30,000	0·65	30,000	0·44	30,000	0·31
Net cost of gas—Net coal	28,200	1·23	56,500	1·23	84,600	1·23	118,000	1·23
Wages	9,150	0·40	18,300	0·40	27,600	0·40	38,400	0·40
Salaries	3,440	0·15	6,880	0·15	10,300	0·15	14,400	0·15
Purification	2,290	0·10	4,600	0·10	6,900	0·10	9,600	0·10
Pumping gas	7,550	0·33	15,100	0·33	22,700	0·33	31,600	0·33
Total Expenditure	238,220	10·40	326,820	7·12	444,335	6·46	591,500	6·16
	£	Pence per therm	£	Pence per therm	£	Pence per therm	£	Pence per therm
Revenue of Gas Undertaking :								
(*a*) Domestic fixed charges	—	—	80,000	—	89,000	—	93,000	—
(*b*) Industrial fixed charges	—	—	2,250	—	6,500	—	7,500	—
(*c*) Gas at flat rate	238,220	—	32,500	—	17,800	—	11,300	—
(*d*) Gas at 6d. per therm	—	—	231,250	—	296,000	—	347,250	—
(*e*) Gas at 4d. per therm	—	—	16,700	—	70,830	—	137,500	—
Total Revenue	238,220	10·40	362,700	7·90	480,130	7·00	596,550	6·22

economical way of warming the air of a room sufficiently to give a background to radiant heat than by the use of flueless gas appliances. Properly designed installations can give the comfort of partial central heating in every home at a low cost. At present this point of view might be challenged on the grounds that the products of combustion are objectionable. Let us see what are these products. Carbon dioxide and water vapour result from the combustion of gas and also from the respiration of human beings, but there is an important difference. Air expired by human beings contains also organic matter and bacteria while the products from gas appliances are sterile. Ventilation is necessary to remove the products of human respiration and does, at the same time, remove the products of gaseous combustion, which, being hot, assist the process of ventilation. There is, however, a "but". The products of gaseous combustion are quite harmless, but they may be distinctly objectionable if they contain, in addition to carbon dioxide and water vapour, any substantial quantity of sulphur dioxide. It is technically possible without undue cost to remove the sulphur from gas to such a degree that its presence in the products of combustion is undetectable by the user. Such a standard of purity is one of those which we must accept as part of good gas service in the future.

It is sometimes said that the establishment of standards destroys initiative, but surely the standards themselves have been created through the initiative of individuals, and it is to be expected that, while prescribed standards will form the minimum for general performance, there will always be men of initiative aiming to do far better than the minimum. We must be prepared to follow the lead that they give and established standards must never come to be regarded as final, but must be subjected to constant revision as the technical level of achievement is raised by the initiative of individuals.

The growth of a living plan demands that the personnel of the Industry shall be able to appreciate the implications of the scheme as a whole and that each individual shall be aware of his definite responsibility within that scheme.

The possibilities of developments in the chemical conversion of coal and the utilization of its products are so great that we may reasonably expect to attract, as indeed we shall need to do, some of the keenest brains and most courageous technicians in the country. Already we can see the very great technical advantages to be obtained by producing and handling gas at pressures of many atmospheres, and by using a range of temperatures from the highest that we now employ down to that of liquid air. We know, too, some of the possibilities of chemical synthesis from simple molecules. The practical application of these principles will not be brought about by the suppression of initiative; rather does future development require that greater scope and opportunities should be given to the younger men whose ideas are less likely to run in the traditional grooves.

In my Presidential year, it has been a matter of outstanding satisfaction to me to have been brought into contact with a very large body of men in the Gas Industry who are determined to see that our Industry shall take its proper place in the Great Britain of the future.

The 1943 edition of the *Year Book of the Coke Oven Managers' Association* (published for the Association by Benn Brothers, Ltd.), contains as usual the transactions for the past year and the examination questions, results, and reports of the City and Guilds of London Institute. A continued increase in membership and good attendances at all sectional meetings are recorded, and the hope is expressed in the Editorial Committee's preface that the Technical Research Advisory Committee formed during the year will soon begin to bear fruit in its endeavours to establish matters of practical research, and possible co-operation with other bodies.

NEEDS OF TO-DAY AND TO-MORROW*

By G. E. STEVENSON, Long Eaton

THE following remarks do not unanimously express the opinion of our own Council, but represent my own personal reaction to the trend of thought existing in the minds of members of the British Joint Junior Gas Association. The Association should meet more frequently. I realize there is the item of the cost of meetings, which cost is borne equally by the Associations sending representatives, but I believe that more frequent meetings are the only way to establish firmly complete understanding, and eventually to place the claim of juniors to greater recognition. This is demonstrated by our decision to apply for affiliation with The Institution of Gas Engineers. This affiliation is our first step towards obtaining recognition, and we cannot hope, or justifiably expect, that our representation could be greater than one member of the Joint Council to the Institution Council and, incidentally, a corporate member of the Institution. Our representative on the Institution will become the spokesman for all juniors, conveying, in turn, the views of the Institution direct to us, instead of through the present channels of information, which are not first-hand. Unfortunately, there is opposition in some quarters, suggesting that we should delay applying for affiliation on the grounds that the present is not appropriate, in view of the probability of the formation of a new national body embracing all the numerous existing units. I do not take that view. The Institution of Gas Engineers, being a Chartered Institution, will always retain its identity, notwithstanding the formation of the proposed new body, which would have functions differing essentially from a purely technical Institution.

Regarding standardization, I believe that the understanding and co-operation existing between individual appliance manufacturers and also between the appliance manufacturers and the gas undertakings is a happy augury. The amount of evidence given by members of the Gas Industry to the I.G.E. Standardization Committee, which operated under the extremely able chairmanship of Mr. F. B. Richards, was complex in character, involving widely divergent views from all parts of the country. No one can doubt that the result of the sifting of this evidence will be of great benefit to the Gas Industry and to the community in general. It is to be hoped that the broad outlook displayed by those responsible for the setting-up of a Committee of this representative type to investigate the standardization of domestic gas appliances will, in turn, be applied to other aspects of our Industry in need of similar co-operation.

Mr. T. F. E. Rhead gave the Association an Address on the Gas Engineering Advisory Boards.

The theme of the Address was that travelling laboratories should be set up in districts to be decided upon, and staffed, in the first place, by chemists from the larger undertakings. The services of this staff and equipment would then become available to smaller undertakings willing to participate in the scheme on a contributory basis, and enable better results to be obtained and a better gas distributed. Although I am attached to an undertaking of medium size, which is able to carry out all normal technical control, we are also (through Gas Consolidation Ltd.) associated with smaller undertakings unable, for obvious reasons, to provide themselves with technical staff. In spite of difficulties at the present time we have attempted, with some little success, to ease the burden of the managers of these smaller undertakings by giving such assistance.

The future of the Gas Industry in some measure lies in our ability to provide the consumer with a universally constant quality of gas. It is therefore clear that in any part of the country an undertaking supplying a high-grade gas is adversely affected by smaller surrounding undertakings supplying gas of an inferior quality. It is not, however, easy for those connected with large undertakings readily to appreciate, without actual experience, the problems confronting a small country gas-works manager. Personnel of the right type are becoming increasingly difficult to obtain. It cannot be emphasized too much how the task of a small gas-works manager can be eased by a little technical assistance given in a co-operative spirit on the lines suggested by Mr. Rhead, not only from the financial and technical points of view of the undertaking, but also in determining the correct use of labour. Some of the instances of the lack of technical control which I have in my limited experience encountered, and without specifically mentioning any particular case, can only be described as appalling. Yet we know that these conditions continue for years, to the detriment of the finances of the undertaking concerned and, from the wider point of view, the prestige of the Gas Industry as a whole. I therefore welcome the scheme so admirably put forward by Mr. Rhead. I should even like to suggest that Mr. Rhead should not be satisfied with leaving the scheme at purely technical control, but should enlarge it and embody the services of practical gas-works mechanics, suitably equipped with travelling workshops containing lathes, drilling machines, welding plant, and spares often found lacking (in the absence of a stores), so that work normally beyond the scope of the small works could be carried out. The services enumerated have been practised by Gas Consolidation and the Severn Valley Gas Corporation for some years with undoubted success.

* From a Presidential Address to the Midland Junior Gas Association.

What direct effect the Beveridge Scheme may have on the Gas Industry it is difficult to estimate, but one thing is clear—that as a result of raising the status of that portion of the population more directly affected by the Report a corresponding increase in the standard of living of the entire population will take place. This, consequently, will produce a vast new demand for houses of an improved type (the number estimated in official circles is in the region of 500,000), and to satisfy the desire for labour-saving new potential fields for the supply of heat on tap, and smokeless fuel, will be created. As an Industry, therefore, we must consider in what way we can respond and obtain a fair portion of this business. There will be severe competition from the electrical people in this direction. They, like ourselves, will strive to maintain the high output attained as a result of the war.

At the present time one of the principal gas appliance manufacturers of this country is carrying out important and far-reaching research work in the use of gas for domestic purposes, and it is fair to suppose that similar activity is taking place in the electrical industry. As an Industry we must make contact with every phase of national and local administration concerned with post-war planning.

There remains within the Industry the tendency to advocate the "all-gas house," which I think is a fallacy. There is no room for such a mental outlook to-day. The sooner we face up to the fact that electricity, with conditions peculiarly adapted to it, has come as a permanent blessing for mankind, the better it will be for us. It is as vital to the nation in home and factory as it is to us in the manufacture of gas. As soon as we recognize this fully, and apply our efforts to directions in which we are, or can be, pre-eminent, the better our service will be. Another fallacy which has to be exploded is that a comparison of the relative efficiencies of a gas-works with an electric power station is likely to appeal to the lay mind and cause people to turn their favour to gas. Except from a point of view of academic interest, I cannot see how it could enter into the matter. Pursuing it will get us nowhere.

The Industry should have a spokesman of real ability and standing. We must have new and more progressive tariffs, and greater research in all directions, on a scale hitherto considered impossible. We must attract new and better personnel into the Industry by offering adequate salaries, and by co-operation with the education authorities.

I should like to see the possibility of compressed coal gas thoroughly explored. That there is a demand for bottled gas is proved by the success of Calor gas, &c., for use in works and factory as a means of cutting in place of acetylene, when coal gas is not available. In country houses, yachts, caravans, house-boats, &c., the demand for bottled gas for a wide number of uses was rapidly extending, but this represents only a small part of the potential demand. On examining an Ordnance map one realizes the number of hamlets and villages which have very little or no chance of ever obtaining a direct supply of town gas. The possibilities of compressed coal gas to supply the need is, I believe, very great. There may have been objections in the past, and still are, to such a scheme, but I believe they can be overcome. It is possible to obtain compressors which will operate with complete reliability at very high pressures, and suitable cylinders can and are being made of light and strong material. Another possibility which cannot be ignored is that of motor-car propulsion.

It is probable that we shall have difficulty in marketing both coke and tar at a reasonable price after the war. With coke a good market has an important influence on the balance-sheet of any undertaking, and I believe that strenuous efforts must be made to improve existing open coke-grates, particularly from the point of view of rapid gas ignition. After some years of practical experience in the use of coke grates, I believe quick ignition to be of the greatest importance, in view of immediate difficulties in changing materially the characteristics of our coke. I believe that the public only require to be taught how to use coke to respond readily to its general acceptance. The use of coke under wartime conditions in open grates has increased enormously.

With regard to tar, I am inclined to the view that it will be used less and less on the highways. Its use is not even mentioned in the reports I have read of schemes being put forward by the Institution of Highway Engineers for new high-speed motor roads planned for construction after the war, but reference to the use of concrete on these roads is mentioned. The small maintenance needed, under war conditions, further advocates the extended use of concrete. As a keen motorist I prefer concrete roads, when the surface is suitably treated to prevent skidding. It is clear, therefore, that some important fresh development has to be made in connexion with the disposal of tar.

The gas engine has always appealed to me as one of the most attractive outlets for gas. I realize that the principal limiting factor is running cost compared with a diesel engine, and that at pre-war values gas had to be sold at something like 3d. per therm to be considered competitive with oil at, say, £5 per ton. In view of the probability of high-grade oil cost after the war, it is possible that gas could be competitive at 4d. per therm—a price many undertakings are accepting for less attractive loads. The conversion of existing

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oil engines, by the installation of modified cylinder heads, is worthy of consideration, especially as we know that some existing engines can be changed over from oil to gas almost instantaneously.

The modern high-speed gas engine is compact and simple in design, and normally, from a maintenance point of view, shows a distinct saving compared with an oil engine running under similar conditions. Figures of the order of 100,000 running hours before the renewal of liner and piston are often experienced, as against an average figure of 70,000 for the oil engine. Maintenance of the gas engine is simplicity itself, and a scheme similar to that adopted by the South Metropolitan Gas Company for the periodical servicing of engines would be an attraction if introduced by the Industry generally, and in itself a form of service to which the oil engine people could hardly have a complete answer. I am certain that the engine manufacturers would gladly co-operate with the Gas Industry in any direction possible in the re-introduction of the gas engine. A further point in our favour is the use of home-produced fuel, a policy which we are told is to be encouraged in the future.

FUEL ECONOMY IN GAS WORKS

No. 9

We are indebted to the Severn Valley Gas Corporation, Ltd., and Gas Consolidation, Ltd., for permission to reprint a series of notes specially compiled for them by G. M. Gill.

SUGGESTIONS FOR IMPROVING CONDITIONS IN SMALL WORKS

IN previous articles considerable space has been devoted to the conditions in small works, the reasons for bad and variable gas, the causes of waste of fuel, and so on. It is now proposed to discuss means for improving these conditions.

System of Retort House Routine Inspections

The Author suggests the adoption of a routine of daily inspection, on strictly systematic lines as set out below, of the retort house working by the manager, or in some cases by a qualified assistant or foreman. He considers that the manager, if thoroughly practical, is much the best man to do this job.

With the average coal which is now being received, degraded though much of it is with ash, it should be practicable to make at least 68 therms of gas—*i.e.*, 13,600 cu.ft. of 500 gas—provided the ordinary methods of sound carbonizing are followed. Managers are urged to apply these methods.

What are the "ordinary methods of sound carbonizing"? They can be summarized as follows:

1. To ensure that the combustion chamber is really hot. Make an inspection every day—it should be at least 1250°C. from end to end, that is, a bright orange colour; it should be hot enough to ensure that the retorts will carbonize completely 3 cwt. coal in 6 hours per 10 ft. retort.

2. Then open the producer charging door. Is it full enough? It should be always at least 3 ft. in depth as an absolute minimum and filled often enough, usually a minimum of 4-hr. intervals, and always at once after clinkering. Then close the door and make sure that it closes properly and does not permit of any air passing in and of any producer gas passing out.

3. Then open the clinkering door and prod the fire with a light pricker bar, and make sure there is no clinker hanging up on the side walls nor any on the back wall and that there is no excessive clinker anywhere on the step plates. See that the ash pit is dry but also that a reasonable amount of water is flowing on to the step plates. Then shut the door and see that it shuts properly, so ensuring that *all* air must pass through the primary air openings. Note the measurements of these openings. If the door does not close properly and air is leaking into the furnace through cracks on the outside of the door, allowance should be made for this and the primary air openings should be reduced proportionately. This may entail the adoption of a method of trial and error.

While in the clinkering pit, ensure that all secondary and waste gas plug holes are properly clayed up. *No* air should gain admittance at these points. Have a look to see whether there is an accumulation of flue dust in the waste gas flues.

4. Next inspect the sight holes in the setting. Note the appearance in each. Is there any blue flame in those under the bottom retorts? If so, it indicates that the producer gas is not being fully burnt. It is possibly due to too little secondary air, or it may be due to blockage of secondary air flues or nostril holes. A rough and ready means of regulation is to push in the secondary air slides until a blue flame appears in the flue under the bottom retorts, then pull out the secondary air slide until it disappears, thus showing that all the producer gas is being burnt. It is important to carry out regulations of air slides under average conditions in the producer, and not just before nor immediately after the producer has been filled or clinkered.

5. Next note any leaks of gas from mouthpiece joints or lids, ascension pipes, dip pipes, or hydraulic mains. Count these and make a note of the number. Then check back the retort house governor or the exhauster so that there is 1 in. pressure on the retort setting. There must be a U gauge for this.

Count and note all the leaks with the plant under pressure. Mark these with chalk and have all stopped with clay and later permanently remedied. This means as a rule cleaning mouthpiece lid joints and then keeping these clean or possibly readjusting the fittings, or remaking mouthpiece socket joints. Re-making joints on ascension pipes, &c., may be shown to be necessary. If fenders are not in use make arrangements to have these fitted and used, and so keep mouthpieces in much better and cleaner condition.

Until all faults are permanently remedied stop with clay all gas leaks which show up under 1 in. pressure, and also all those gas leaks which can be seen after charging. Bear in mind that a gas leak from a freshly charred retort becomes an air inlet an hour or so later and then it is no longer visible.

6. Ease back slightly the levers of each mouthpiece, say, $\frac{1}{8}$ in., and note pressure or vacuum, or slight oscillation as shown by the gas coming out. If there is the slightest sign of sustained pressure, then this clearly indicates a partially stopped ascension pipe or stoppage further ahead. Tackle this at once. If the gas is not visible when the lever is slacked back it is a clear sign of too much pull on the retort or that the charge is burnt off. Much can be learnt from this practice, which only takes a minute or so to do.

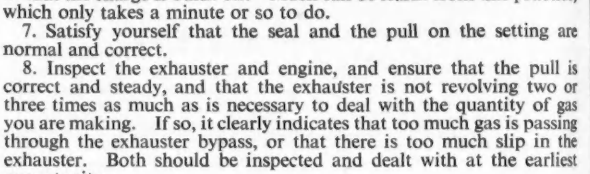
7. Satisfy yourself that the seal and the pull on the setting are normal and correct.

8. Inspect the exhauster and engine, and ensure that the pull is correct and steady, and that the exhauster is not revolving two or three times as much as is necessary to deal with the quantity of gas you are making. If so, it clearly indicates that too much gas is passing through the exhauster bypass, or that there is too much slip in the exhauster. Both should be inspected and dealt with at the earliest opportunity.

9. Personally inspect at least half the retorts in use some time each day—*i.e.*, all retorts each two days—when these are opened for discharging and also when these are empty. Note whether the retorts are too dull or too hot, and whether the charge being pulled out was good and level, and properly burnt off. If not, leave a note for the stoker who charged these retorts.

Are there any holes or cracks? If so, repair these, and properly, with a paddle and a good repair fire cement. Never charge coal into a retort with a hole or crack in it; and impress this upon all the stokers. In all well-managed small works, and large too, there is always a bucket of fire cement and a paddle close at hand for the stoker to do the job at once before charging. Adopt this method immediately if not already in use.

Note also whether any retort needs scurfing. Keep a gauge for this in the retort house. Any gas fitter can make one in an hour or so from $\frac{3}{4}$ in. pipe. Thus:



Is there any scurf in the front of the retort or on the mouthpiece to catch the coal during charging? If so, have it cut off.

Note also whether the mouthpiece joint is in good condition on the inside, or does it need filling in with fire cement?

Never allow the stokers to open any retort without first lighting the gas. If not, the explosion caused is certain to result before long in leaky joints between the retort and the mouthpiece or in the bottom

ascension pipe joint. Such leaky joints will bring about the admission of much air into the gas, spoiling the results and causing stopped pipes.

10. Make the stokers use backing rakes for pushing the coal off the mouthpiece into the retort. This saves a lot of coal in the aggregate and prevents much tarry mess from being drawn out on to the mouthpieces and fittings, so causing these, if there are no fenders, to become leaky and dirty and to require constant cleaning.

Retort House Tools for Small Works

11. Inspect the tools in use. Have you a complete double set of all the necessary tools? This is important, particularly in these days of long deliveries.

A complete set should consist of:

	Length.
1 Hand rake	14 ft.
1 Lighter hook (opening lids)	4 ft.
1 Chipper (cleaning lids and mouthpieces)	3 ft. 6 in.
1 Backing rake	4 ft. 6 in.
1 Scurfing bar	12 ft.
1 " "	8 ft.
1 " "	5 ft.
1 Patching paddle	12 ft.
1 " "	8 ft.
1 " "	5 ft.
1 Hot coke barrow.	
1 Coal barrow to hold 3½ cwt.	
1 Auger, 5½ in diameter—for a 6-in. pipe	7 ft. 6 in.
1 " 4½ in diameter—for a 6-in. pipe	12 ft.
1 Spud bar	6 ft. 6 in.
1 Clinkering hook	6 ft. 6 in.
1 Pan shovel.	As required.
1 Charging shovel	"
1 Coal shovel	"
1 Coke fork	Tines with 1-in. spaces.

Always pride yourself upon the condition and completeness of all the tools you have in use. Few things will please the men more than this consideration on the part of a manager; and incidentally, nothing stamps a bad manager more than the poor condition of the tools which he expects the men to use.

The regular observance of this set of rules on the part of the manager will not occupy him more than an hour a day in all, and possibly less after this practice has been adopted as a regular routine. The result will undoubtedly surprise those who have not hitherto paid regular attention to their retort house, where, after all, at least 80% of all gas-works expenditure is incurred, if we include as we should the value of the coke used in the producers.

Calorific Value

The Author suggests that all works with no satisfactory means of diluting coal gas should supply gas of not less than 500 B.Th.U. What is a satisfactory means? It is suggested that a satisfactory means is as follows:

1. Dilution by benzole washing.
2. Dilution by blue gas or carburetted water gas—*i.e.*, made in a water gas plant or in a continuous or intermittent vertical carbonizing plant.
3. Dilution by a combination of both.

Some will assert that this would be a hardship and at first sight this may appear to be the case, but the Author is confident that the change-over would lead to important advantages and a good saving in fuel in those cases where gas is being supplied of less than 500 B.Th.U. per cu.ft. from gas-works without any satisfactory means of diluting the coal gas. Practical men know quite well that horizontal plant was designed to make a rich luminous gas of at least 600 B.Th.U. for lighting purposes, while the same plant is now being used to produce a gas, as Dr. Smith pointed out at Bristol recently, which may be anything from 400 B.Th.U. and upwards. The means adopted is by degradation of one sort or another and frequently by the worst method of all—that is, by admission of air through leaky mouthpiece and lid joints.

The case against a standard 500 B.Th.U. for all works without satisfactory means of dilution would be:

1. Some managers would claim that, due to over-worked plant, retort settings in bad shape due to lack of repairs and renewals, or to inexperienced, insufficient or poor quality of labour, it would be impossible to raise the quality of the gas to 500 B.Th.U.

2. The coal often supplied nowadays—house coal and the like, also coal which is overloaded with ash—would render it impossible to supply 500 B.Th.U. gas.

3. Gas undertakings now supplying, say, 450 B.Th.U. gas with slots set at, say, 10 cu.ft. per 1d. would have to alter these to 9 cu.ft. per 1d. to give equivalent value in therms. The consumer would think it was a swindle, or at best another rise in price. It would be difficult to convince him that he would be no worse off, but probably better off.

To deal with these points in order:

1. The Author claims that the necessity of raising the quality of, say, 400 or 450 B.Th.U. to 500 in any small works would result in the manager being compelled to adopt more efficient methods and, in fact, to put in force some of the remedies which have been explained in the series of articles on Fuel Economy in Gas-Works. The methods described are simple and effective, and would rapidly have the desired effect. In none of the small works with which the Author is concerned would the raising of the calorific value to 500 B.Th.U., in his opinion, present the slightest difficulty.

2. It is true that most coals have been degraded to some extent during the war, and quite a quantity to a disgraceful extent. The Severn Valley Coal Testing Laboratory is always at work testing coal samples sent in from resident and travelling chemists in accordance with a pre-determined programme covering routine tests of all coals used. The figures set out below are of routine tests—that is, the coal was not sampled and tested in these cases because the quality was suspect.

CALORIFIC VALUE OF GAS FROM VARYING QUALITIES OF COAL.

	Number of samples tested.	Average ash %.	Average calorific power B.Th.U.
Coal A	5	5.2	572
" A	3	13.3	577
" B	4	4.1	571
" B	4	7.3	566
" C	7	5.1	557
" C	8	8.4	568
" D	4	6.1	557
" D	6	12.4	553
" E	6	8.3	543
" E	8	13.9	566
" E	4	20.0	547
" F	5	4.3	555
" F	10	7.5	581
" F	7	15.2	579

N.B.—All the above samples have been tested since January, 1942, with a retort wall temperature of 1000°C. and with level gauge in the retort.

As will be observed, high ash coals still produce gas of high B.Th.U., no lower, in fact, than coals with a low ash percentage. This is in accordance with the Author's practical experience in works, and he does not believe that bad coal is a good or valid excuse for making gas of lower calorific value in a horizontal retort plant.

Certainly the use of bad coal with a high ash content can easily and completely disorganize a retort house—that is to say, make it virtually impossible to keep producers at work, and as a consequence the heats are seriously decreased and the make of gas is reduced to a considerable extent. But with coal of that kind it would be very foolish to put the resultant coke into the producer unless of course there was no other coke to use. Normally there is other coke to use by charging the retorts for the firing draw with good coal, and so at any rate keeping the heats up to the mark.

Such practice is, of course, very bad for the coke customer, but the gas manager has virtually no choice in the matter. Incidentally, the Author, who was compelled by the coal control to use a certain very bad coal, at once instructed all the works concerned to ensure that none of the coke from that particular coal was put into the producers. But that particular coal with an average ash percentage of 13.87 (14 tests) varying from 5.25% to 32.8%, still produced gas with an average calorific value of 551, with a minimum of 511 B.Th.U. and a maximum of 575 B.Th.U.

No. 3 is one of those difficulties which are minimized considerably during the war. If slot consumers were told that the cost to them would actually be unchanged, they would probably grumble but the change in these days would be likely to cause little criticism.

The Author is convinced that there would be a general improvement in carbonizing technique and in fuel economy by raising the calorific value to 500 B.Th.U. in all works where that is no satisfactory means of dilution, and where the gas supplied is of lower calorific value.

It would cut out in many cases the admission of a great deal of air which is now burning gas inside the retorts and ascension pipes, which fault also causes stopped pipes with a further loss of gas and waste of coal. It would reduce the corrosive properties of gas in gasholders, mains, service pipes, meters, and gas appliances. It would lighten the gas and so increase the capacity of mains and service and supply pipes. It would again increase the capacity of most of the works plant, and also of the whole of the distribution plant, consumers' meters, and supply pipes by reason of the fact that 1,000 cu.ft. would contains five therms instead of some lesser quantity.

The above two proposals would in the Author's opinion be calculated to improve conditions in many of the small works and in a good number also of larger works.

The Accrington Town Clerk has been instructed to inquire into the engagement of a street lighting expert to advise on the proposed new main road lighting scheme.

The Torquay and Paignton Gas Company gave valuable assistance to the Ministry of Health's campaign to recruit nurses by lending their showrooms and demonstration theatre for a Nursing Exhibition opened by Mr. Ernest Brown, M.P., Minister of Health, on May 21. The exhibition included a comparison of wards of an old and new hospital, army field medical equipment, and gas cooking and refrigeration apparatus for hospital and ward kitchens; lectures and film shows supported the exhibition. A meeting in the Town Hall preceded the opening of the exhibition. The Mayor of Torquay (Ald. J. W. Gentle) presided, and the gathering included the Mayoress, Mr. Charles Williams, M.P., and Sir John Daw, Chairman of the Devon County Council.

UNDERGROUND GASIFICATION OF COAL*

By HAROLD ROSE, B.Sc., A.I.C., A.M.I.Chem.E.

THE idea of converting coal to gas in the seam is not new. The possibility was first mentioned by the Russian chemist, Mendeleev, in 1888, and somewhat later by Sir William Ramsey in this country. Although the idea attracted a certain amount of attention in other countries, little practical work was carried out beyond the laboratory stage. In fact, no country took the matter seriously until Lenin, attracted by the project outlined in the British Press in 1913, coupled the problem with the plan for electrifying the U.S.S.R. The Soviet authorities were immediately attracted to the advantages which the scheme offered.

By utilizing poor seams of low quality coal, which were uneconomical or impractical to work, their potential coal reserves could be increased enormously. The reduction in the transport of coal over long distances would be a great advantage to such a vast country as Russia, where fuel supply has to be transported over hundreds of miles as a matter of course. The elimination of underground mining would provide cheaper fuel and power, which would, in turn, influence all industrial activities. The provision of low cost gas as a possible source of raw materials for the production of synthetic fuels and chemicals offers an additional attraction, and not the least important is the enormous amount of arduous human labour which would be saved, as a result of which society as a whole would reap benefit.

Experiments on single shafts were first carried out in 1933 in the Donetz Basin, and gradually the work extended to experimental stations, first built in 1937; finally, in 1940, the first industrial station was opened in the Moscow Basin. The Third Five Year Plan, 1938–1942, incorporated a project for the construction of several new plants in the Donetz and Moscow coalfields, in the Urals, Eastern Siberia, in Central Asia, and the Far East. Provision was made in the plan for the building of two stations where the control of the plant could be carried out automatically in a central control room. To give some idea of the size of these industrial plants, the projected station at Lisichansk, in the Donetz, was expected to have a daily output of 20 million cu.ft. of gas, with an average calorific value of 275 B.Th.U. per cu.ft. Two other stations with a daily output of 14 million and 8 million cu.ft. respectively were included in the project.

In the first experiments the seam was converted into a number of underground gas producers, by first reducing one or more panels to fragments before ignition. This method, however, was found to be unsatisfactory, and was abandoned in favour of methods which reduce underground mining operations to the minimum.

There are at least three methods available, each of which is applicable to a particular type of seam, the deciding factors usually being the inclination and depth of the seam.

(i) *Stream Method.*—This is perhaps the most successful and firmly established of all methods, and is particularly suited to steeply inclined seams. A gallery, which acts as the fire shaft, is driven along the seam, and two shafts some 200 to 300 yards apart are taken upwards along the seam to the surface. The coal is ignited and combustion maintained by blowing compressed air down one shaft, the combustible gas being tapped off at the second shaft. In this way the fire burns progressively upwards along the seam to the surface. Starting-up usually takes from two to ten hours, after which gas is produced continuously without further attention.

At one experimental station in the Donbas, working on a 6 ft. thick seam, inclined at an angle of 75°, gas was produced without interruption for 18 months, during which time 250 million cu.ft. of power gas and 70 million ft. of synthetic gas were produced.

(ii) *Filtration Method.*—This method is used for horizontal seams and requires no preliminary underground mining operations. A number of bore-holes, reaching to the seam, are arranged in concentric circles, and air is pumped down through the centre boring, the gas being withdrawn from the bore-holes of the first ring. When the gasification of this section is complete, the air is then pumped down the first ring of borings and the gas withdrawn from the next concentric ring. The bore-holes are interconnected, so that the gas underground passes through cracks and crevices from one bore-hole to those adjacent to it.

(iii) *Bore-holes and drilling method.*—This virtually is a combination of the previous two methods, and is considered suitable for gently sloping seams. If a low-grade coal is used, the air may be enriched with oxygen, or, if steam is added to the blast, a semi-water gas is obtained.

Some of the gas penetrates into faults in the seam and to the surrounding rock. This gas may be recovered by discontinuing the air blow while the gas is being pumped off. A gas rich in hydrogen is obtained in this way, which is eminently suitable for the production of synthetic fuels and chemicals.

The process can be divided into two cycles. During the air blow, power gas with a calorific value of 115 B.Th.U. per cu.ft. is obtained, while during the blow-off period a synthesis gas is obtained with a calorific value ranging from 170 to 220 B.Th.U., and with a hydrogen content which might reach 55%. If the air blow is enriched with oxygen up to 25%, these calorific values may be increased by 50% or more.

If we can judge from the considerable amount of expenditure on research and development in the U.S.S.R., and from the results published, it would appear that, although major technical problems yet remain to be solved, the teething troubles are over and the underground gasification of coal may be considered as an established fact.

Most of the published results are based on the operations of the large experimental station at Gorlovka, in the Donetz, and some of these are worthy of study. Whereas the monthly output of each miner in this Basin is 30 tons a month, the output of each operator at the underground gas station, in terms of coal equivalent, is 75 tons; thus, the productivity of each operative is more than doubled. If this figure can be achieved at an experimental station, it has been estimated that a large industrial station can increase the output per operator by 12 to 15 times as compared with conventional mining methods.

Since 80 to 90% of the fixed capital goes into surface work, and the remainder into the preparation of the panel, there is a considerable saving in the cost of operation, which has, in fact, already led to a reduction of the cost of power gas to one-third of its usual cost.

The possibilities that present themselves are great. In the first place, shallow seams and poor deposits of coal, which cannot be profitably worked by conventional mining methods, could be successfully dealt with by underground gasification.

The gas plant, now transferred to the pithead, could distribute low cost gas to industry, which might be handled through a regional scheme, along the lines of a gas grid. Alternatively, the gas may be used for cheap power generation on the site by means of a gas turbine. The Kharkov Mechanical Engineering Institute has, in fact, brought out the first industrial gas turbine which will operate exclusively on underground gas. The power generated can be linked up with the existing grid, and will incidentally supply the requirements of the station itself and the industries centred around the station, using as raw materials the products of gasification. For it is in this direction —the utilization of the synthesis gas for the production of industrial fuels and chemicals—that the process offers so much promise. The gas produced provides the basic raw material for the synthetic production of a number of key industrial chemicals.

We can envisage the possibility of replacing the monstrous slag heaps at the pithead by highly mechanized gas stations, coupled with thermo-electric and electro-chemical enterprises, running on cheap power, together with a group of synthetic chemical industries, the whole forming one integral unit running entirely on the gas generated from the seam, without a human hand having to touch the raw coal. The installation of such centralized industrial combines is bound to have a marked effect on industry as a whole by stimulating new industries and by the general lowering of the costs of production.

The Gas Industry might well take the trouble to investigate the possibility of gasifying coal underground in this country. The technicians we have. What we require are foresight and the establishment of adequate funds to enable the necessary scientific research to be carried out.

* Abstract of a Lecture at a Conference of the North-Western District of the B.C.G.A., Manchester, May 28.

Parkinson & Cowan, Ltd.

A profit of £48,423 for the year ended Dec. 31, 1942, compared with £45,395 for the previous year, was recorded at the annual meeting of Parkinson & Cowan, Ltd., in London, on May 26, when an Ordinary dividend of 5%, less tax, was declared. In his statement to the shareholders, Lt.-Colonel H. W. Woodall (Chairman) pointed out that increased turnover and profit bore little relation to the amount available for distribution, in view of the heavy provisions necessary for taxation. Although the profit of the trading subsidiaries amounted to £234,792, only £61,208 was left as net profit for the year after provision for income tax, E.P.T., and reserves for deferred repairs. The activities of the Companies operating in Australia had been severely restricted by the war situation, but, while difficult times would undoubtedly continue, the position was improving, and every effort would be made to recover the situation in the shortest possible time.

Due to the exigencies of the war, the Company's efforts had been almost exclusively directed to wartime production, but in spite of this, serious thought and attention were being given to post-war problems. The works were operating on a scale of engineering and scientific efficiency much in advance of pre-war requirements, an advance which should place the Company in a greatly improved position to handle post-war problems. In these times, when every day brought its own man-power problems and when every fresh development of the fighting services was immediately reflected in altered industrial requirements, the Company's thanks were more than ever due to the staff and workpeople for the efficient and unflagging energy they brought to bear upon their tasks.

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Gas Products Prices

The London Market June 7.

All Coal Tar Products are in good demand, and Pitch in the London area remains about 45s.

Attention is called to a new Government Order which has just been issued, the Control of Coal Tar Naphtha and Xylole Order, 1943 (S. R. & O. 1943, No. 768).

This new Order differs from the old 1942 Order mainly in the fact that it embraces the supply of these commodities in very small quantities.

Apart from this there is nothing of interest to report.

The Provinces June 7.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 10d., pure, 2s. 5d. (controlled by the Control of Toluene No. 2 Order, July 3, 1941, which fixes the maximum price at which this material may be sold). Naphtha and Xylole controlled by the Coal Tar Naphtha and Xylole Order, 1942, dated Dec. 7, 1942, and operative from Dec. 21. Carbolic acid, 60's, naphthalene, and anthracene controlled by the Coal Tar Products Prices Order S. R. & O. 2509, dated Dec. 7, 1942, and operative from Jan. 1, 1943. Filtered heavy oil (min. gr. 1,080), 7¼d. to 8d. Creosote oil has been generally controlled as to direction and price for some time past. Current value—fuel grades 5d. to 5¼d.; timber preservation and other purposes 4¾d. to 6d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Tar Products in Scotland June 5.

Throughput is well maintained. Refined tar controlled. Value is 4½d. per gallon *ex* Works, naked. Creosote oil: Specification oil, 6½d. to 7d.; low gravity, 7½d. to 7½d.; neutral oil, 6d. to 6½d.; hydrogenation oil, 5⅞d. per gallon; all *ex* Works in bulk. Refined cresylic acid is in good call at 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha: 6½d. to 7d. per gallon. Solvent naphtha: Basic prices delivered in bulk, 90/180 grade 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 3d. per gallon. Pyridine: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

Gas Stocks and Shares

Apart from a renewal of activity in diamond and Rand gold shares, stock markets remained quiet and dull throughout the week.

The volume of business in gas stocks and shares was also on a small scale, although prices with few exceptions continued unchanged. It will be seen that there were fewer improvements in value than of late, and a few issues suffered minor setbacks. This would appear to be in keeping with the all-round dull conditions, and on a resumption of general activity the gas market will doubtless speedily respond. Commercial ordinary was again in good demand and changed hands up to 68, the quotation closing a further 2 points higher.

The following price changes were recorded during the week:

PROVINCIAL EXCHANGES

Bristol Ord.	114—116	+1
Ditto 5 p.c. Deb.	116—120	+3½
Derby 4 p.c. Deb.	92—97	−3
Newcastle Units	23/—23/6	−/3d.

OFFICIAL LIST

Associated Gas & Water Ord.	19/6—20/6	+/6d.
Ditto 4 p.c. Cum. Pref.	17/6—18/6	+/6d.
British Ord.	105—110	+2
Commercial Ord.	65—70	+2
Gas Light 3 p.c. Deb. (*x.d.*)	85—88	May 31
Ditto 5 p.c. Deb. (*x.d.*)	105—109	"
Ditto 4½ p.c. Red. Deb. (*x.d.*)	105—109	"
Primitiva Holdings Ord.	12/6—14/6	+/6d.
Severn Valley Gas Corporation Ord. (*x.d.*)	20/—21/−	May 31
Tottenham Ord.	106—111	+3
Ditto 5 p.c. Pref.	106—111	−1
United Kingdom Gas Corporation Ord. (*x.d.*)	19/6—20/6	May 31

SUPPLEMENTARY LIST

Gas Consolidation "A" Ord.	16/—18/−	+1/−

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oil engines, by the installation of modified cylinder heads, is worthy of consideration, especially as we know that some existing engines can be changed over from oil to gas almost instantaneously.

The modern high-speed gas engine is compact and simple in design, and normally, from a maintenance point of view, shows a distinct saving compared with an oil engine running under similar conditions. Figures of the order of 100,000 running hours before the renewal of liner and piston are often experienced, as against an average figure of 70,000 for the oil engine. Maintenance of the gas engine is simplicity itself, and a scheme similar to that adopted by the South Metropolitan Gas Company for the periodical servicing of engines would be an attraction if introduced by the Industry generally, and in itself a form of service to which the oil engine people could hardly have a complete answer. I am certain that the engine manufacturers would gladly co-operate with the Gas Industry in any direction possible in the re-introduction of the gas engine. A further point in our favour is the use of home-produced fuel, a policy which we are told is to be encouraged in the future.

FUEL ECONOMY IN GAS WORKS

No. 9

We are indebted to the Severn Valley Gas Corporation, Ltd., and Gas Consolidation, Ltd., for permission to reprint a series of notes specially compiled for them by G. M. Gill.

SUGGESTIONS FOR IMPROVING CONDITIONS IN SMALL WORKS

IN previous articles considerable space has been devoted to the conditions in small works, the reasons for bad and variable gas, the causes of waste of fuel, and so on. It is now proposed to discuss means for improving these conditions.

System of Retort House Routine Inspections

The Author suggests the adoption of a routine of daily inspection, on strictly systematic lines as set out below, of the retort house working by the manager, or in some cases by a qualified assistant or foreman. He considers that the manager, if thoroughly practical, is much the best man to do this job.

With the average coal which is now being received, degraded though much of it is with ash, it should be practicable to make at least 68 therms of gas—*i.e.*, 13,600 cu.ft. of 500 gas—provided the ordinary methods of sound carbonizing are followed. Managers are urged to apply these methods.

What are the "ordinary methods of sound carbonizing"? They can be summarized as follows:

1. To ensure that the combustion chamber is really hot. Make an inspection every day—it should be at least 1250°C. from end to end, that is, a bright orange colour; it should be hot enough to ensure that the retorts will carbonize completely 3 cwt. coal in 6 hours per 10 ft. retort.

2. Then open the producer charging door. Is it full enough? It should be always at least 3 ft. in depth as an absolute minimum and filled often enough, usually a minimum of 4-hr. intervals, and always at once after clinkering. Then close the door and make sure that it closes properly and does not permit of any air passing in and of any producer gas passing out.

3. Then open the clinkering door and prod the fire with a light pricker bar, and make sure there is no clinker hanging up on the side walls nor any on the back wall and that there is no excessive clinker anywhere on the step plates. See that the ash pit is dry but also that a reasonable amount of water is flowing on to the step plates. Then shut the door and see that it shuts properly, so ensuring that *all* air must pass through the primary air openings. Note the measurements of these openings. If the door does not close properly and air is leaking into the furnace through cracks on the outside of the door, allowance should be made for this and the primary air openings should be reduced proportionately. This may entail the adoption of a method of trial and error.

While in the clinkering pit, ensure that all secondary and waste gas plug holes are properly clayed up. *No* air should gain admittance at these points. Have a look to see whether there is an accumulation of flue dust in the waste gas flues.

4. Next inspect the sight holes in the setting. Note the appearance in each. Is there any blue flame in those under the bottom retorts? If so, it indicates that the producer gas is not being fully burnt. It is possibly due to too little secondary air, or it may be due to blockage of secondary air flues or nostril holes. A rough and ready means of regulation is to push in the secondary air slides until a blue flame appears in the flue under the bottom retorts, then pull out the secondary air slide until it disappears, thus showing that all the producer gas is being burnt. It is important to carry out regulations of air slides under average conditions in the producer, and not just before nor immediately after the producer has been filled or clinkered.

5. Next note any leaks of gas from mouthpiece joints or lids, ascension pipes, dip pipes, or hydraulic mains. Count these and make a note of the number. Then check back the retort house governor or the exhauster so that there is 1 in. pressure on the retort setting. There must be a U gauge for this.

Count and note all the leaks with the plant under pressure. Mark these with chalk and have all stopped with clay and later permanently remedied. This means as a rule cleaning mouthpiece lid joints and then keeping these clean or possibly readjusting the fittings, or re-making mouthpiece socket joints. Re-making joints on ascension pipes, &c., may be shown to be necessary. If fenders are not in use make arrangements to have these fitted and used, and so keep mouthpieces in much better and cleaner condition.

Until all faults are permanently remedied stop with clay all gas leaks which show up under 1 in. pressure, and also all those gas leaks which can be seen after charging. Bear in mind that a gas leak from a freshly charred retort becomes an air inlet an hour or so later and then it is no longer visible.

6. Ease back slightly the levers of each mouthpiece, say, $\frac{1}{4}$ in., and note pressure or vacuum, or slight oscillation as shown by the gas coming out. If there is the slightest sign of sustained pressure, then this clearly indicates a partially stopped ascension pipe or stoppage further ahead. Tackle this at once. If the gas is not visible when the lever is slacked back it is a clear sign of too much pull on the retort or that the charge is burnt off. Much can be learnt from this practice, which only takes a minute or so to do.

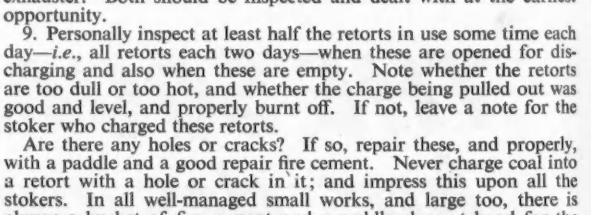
7. Satisfy yourself that the seal and the pull on the setting are normal and correct.

8. Inspect the exhauster and engine, and ensure that the pull is correct and steady, and that the exhauster is not revolving two or three times as much as is necessary to deal with the quantity of gas you are making. If so, it clearly indicates that too much gas is passing through the exhauster bypass, or that there is too much slip in the exhauster. Both should be inspected and dealt with at the earliest opportunity.

9. Personally inspect at least half the retorts in use some time each day—*i.e.*, all retorts each two days—when these are opened for discharging and also when these are empty. Note whether the retorts are too dull or too hot, and whether the charge being pulled out was good and level, and properly burnt off. If not, leave a note for the stoker who charged these retorts.

Are there any holes or cracks? If so, repair these, and properly, with a paddle and a good repair fire cement. Never charge coal into a retort with a hole or crack in it; and impress this upon all the stokers. In all well-managed small works, and large too, there is always a bucket of fire cement and a paddle close at hand for the stoker to do the job at once before charging. Adopt this method immediately if not already in use.

Note also whether any retort needs scurfing. Keep a gauge for this in the retort house. Any gas fitter can make one in an hour or so from $\frac{3}{4}$ in. pipe. Thus:



Is there any scurf in the front of the retort or on the mouthpiece to catch the coal during charging? If so, have it cut off.

Note also whether the mouthpiece joint is in good condition on the inside, or does it need filling in with fire cement?

Never allow the stokers to open any retort without first lighting the gas. If not, the explosion caused is certain to result before long in leaky joints between the retort and the mouthpiece or in the bottom

ascension pipe joint. Such leaky joints will bring about the admission of much air into the gas, spoiling the results and causing stopped pipes.

10. Make the stokers use backing rakes for pushing the coal off the mouthpiece into the retort. This saves a lot of coal in the aggregate and prevents much tarry mess from being drawn out on to the mouthpieces and fittings, so causing these, if there are no fenders, to become leaky and dirty and to require constant cleaning.

Retort House Tools for Small Works

11. Inspect the tools in use. Have you a complete double set of all the necessary tools? This is important, particularly in these days of long deliveries.

A complete set should consist of:

	Length.
1 Hand rake	14 ft.
1 Lighter hook (opening lids)	4 ft.
1 Chipper (cleaning lids and mouthpieces)	3 ft. 6 in.
1 Backing rake	4 ft. 6 in.
1 Scurfing bar	12 ft.
1 " "	8 ft.
1 " "	5 ft.
1 Patching paddle	12 ft.
1 " "	8 ft.
1 " "	5 ft.
1 Hot coke barrow.	
1 Coal barrow to hold 3½ cwt.	
1 Auger, 5½ in diameter—for a 6-in. pipe	7 ft. 6 in.
1 " 4½ in diameter—for a 6-in. pipe	12 ft.
1 Spud bar	6 ft. 6 in.
1 Clinkering hook	6 ft. 6 in.
1 Pan shovel.	As required.
1 Charging shovel	"
1 Coal shovel	"
1 Coke fork	Tines with 1-in. spaces.

Always pride yourself upon the condition and completeness of all the tools you have in use. Few things will please the men more than this consideration on the part of a manager; and incidentally, nothing stamps a bad manager more than the poor condition of the tools which he expects the men to use.

The regular observance of this set of rules on the part of the manager will not occupy him more than an hour a day in all, and possibly less after this practice has been adopted as a regular routine. The result will undoubtedly surprise those who have not hitherto paid regular attention to their retort house, where, after all, at least 80% of all gas-works expenditure is incurred, if we include as we should the value of the coke used in the producers.

Calorific Value

The Author suggests that all works with no satisfactory means of diluting coal gas should supply gas of not less than 500 B.Th.U. What is a satisfactory means? It is suggested that a satisfactory means is as follows:

1. Dilution by benzole washing.
2. Dilution by blue gas or carburetted water gas—*i.e.*, made in a water gas plant or in a continuous or intermittent vertical carbonizing plant.
3. Dilution by a combination of both.

Some will assert that this would be a hardship and at first sight this may appear to be the case, but the Author is confident that the change-over would lead to important advantages and a good saving in fuel in those cases where gas is being supplied of less than 500 B.Th.U. per cu.ft. from gas-works without any satisfactory means of diluting the coal gas. Practical men know quite well that horizontal plant was designed to make a rich luminous gas of at least 600 B.Th.U. for lighting purposes, while the same plant is now being used to produce a gas, as Dr. Smith pointed out at Bristol recently, which may be anything from 400 B.Th.U. and upwards. The means adopted is by degradation of one sort or another and frequently by the worst method of all—that is, by admission of air through leaky mouthpiece and lid joints.

The case against a standard 500 B.Th.U. for all works without satisfactory means of dilution would be:

1. Some managers would claim that, due to over-worked plant, retort settings in bad shape due to lack of repairs and renewals, or to inexperienced, insufficient or poor quality of labour, it would be impossible to raise the quality of the gas to 500 B.Th.U.

2. The coal often supplied nowadays—house coal and the like, also coal which is overloaded with ash—would render it impossible to supply 500 B.Th.U. gas.

3. Gas undertakings now supplying, say, 450 B.Th.U. gas with slots set at, say, 10 cu.ft. per 1d. would have to alter these to 9 cu.ft. per 1d. to give equivalent value in therms. The consumer would think it was a swindle, or at best another rise in price. It would be difficult to convince him that he would be no worse off, but probably better off.

To deal with these points in order:

1. The Author claims that the necessity of raising the quality of, say, 400 or 450 B.Th.U. to 500 in any small works would result in the manager being compelled to adopt more efficient methods and, in fact, to put in force some of the remedies which have been explained in the series of articles on Fuel Economy in Gas-Works. The methods described are simple and effective, and would rapidly have the desired effect. In none of the small works with which the Author is concerned would the raising of the calorific value to 500 B.Th.U., in his opinion, present the slightest difficulty.

2. It is true that most coals have been degraded to some extent during the war, and quite a quantity to a disgraceful extent. The Severn Valley Coal Testing Laboratory is always at work testing coal samples sent in from resident and travelling chemists in accordance with a pre-determined programme covering routine tests of all coals used. The figures set out below are of routine tests—that is, the coal was not sampled and tested in these cases because the quality was suspect.

CALORIFIC VALUE OF GAS FROM VARYING QUALITIES OF COAL.

	Number of samples tested.	Average ash %.	Average calorific power B.Th.U.
Coal A	5	5.2	572
" A	3	13.3	577
" B	4	4.1	571
" B	4	7.3	566
" C	7	5.1	557
" C	8	8.4	568
" D	4	6.1	557
" D	6	12.4	553
" E	6	8.3	543
" E	8	13.9	566
" E	4	20.0	547
" F	5	4.3	555
" F	10	7.5	581
" F	7	15.2	579

N.B.—All the above samples have been tested since January, 1942, with a retort wall temperature of 1000°C. and with level gauge in the retort.

As will be observed, high ash coals still produce gas of high B.Th.U., no lower, in fact, than coals with a low ash percentage. This is in accordance with the Author's practical experience in works, and he does not believe that bad coal is a good or valid excuse for making gas of lower calorific value in a horizontal retort plant.

Certainly the use of bad coal with a high ash content can easily and completely disorganize a retort house—that is to say, make it virtually impossible to keep producers at work, and as a consequence the heats are seriously decreased and the make of gas is reduced to a considerable extent. But with coal of that kind it would be very foolish to put the resultant coke into the producer unless of course there was no other coke to use. Normally there is other coke to use by charging the retorts for the firing draw with good coal, and so at any rate keeping the heats up to the mark.

Such practice is, of course, very bad for the coke customer, but the gas manager has virtually no choice in the matter. Incidentally, the Author, who was compelled by the coal control to use a certain very bad coal, at once instructed all the works concerned to ensure that none of the coke from that particular coal was put into the producers. But that particular coal with an average ash percentage of 13.87 (14 tests) varying from 5.25% to 32.8%, still produced gas with an average calorific value of 551, with a minimum of 511 B.Th.U. and a maximum of 575 B.Th.U.

No. 3 is one of those difficulties which are minimized considerably during the war. If slot consumers were told that the cost to them would actually be unchanged, they would probably grumble but the change in these days would be likely to cause little criticism.

The Author is convinced that there would be a general improvement in carbonizing technique and in fuel economy by raising the calorific value to 500 B.Th.U. in all works where that is no satisfactory means of dilution, and where the gas supplied is of lower calorific value.

It would cut out in many cases the admission of a great deal of air which is now burning gas inside the retorts and ascension pipes, which fault also causes stopped pipes with a further loss of gas and waste of coal. It would reduce the corrosive properties of gas in gasholders, mains, service pipes, meters, and gas appliances. It would lighten the gas and so increase the capacity of mains and service and supply pipes. It would again increase the capacity of most of the works plant, and also of the whole of the distribution plant, consumers' meters, and supply pipes by reason of the fact that 1,000 cu.ft. would contains five therms instead of some lesser quantity.

The above two proposals would in the Author's opinion be calculated to improve conditions in many of the small works and in a good number also of larger works.

The Accrington Town Clerk has been instructed to inquire into the engagement of a street lighting expert to advise on the proposed new main road lighting scheme.

The Torquay and Paignton Gas Company gave valuable assistance to the Ministry of Health's campaign to recruit nurses by lending their showrooms and demonstration theatre for a Nursing Exhibition opened by Mr. Ernest Brown, M.P., Minister of Health, on May 21. The exhibition included a comparison of wards of an old and new hospital, army field medical equipment, and gas cooking and refrigeration apparatus for hospital and ward kitchens; lectures and film shows supported the exhibition. A meeting in the Town Hall preceded the opening of the exhibition. The Mayor of Torquay (Ald. J. W. Gentle) presided, and the gathering included the Mayoress, Mr. Charles Williams, M.P., and Sir John Daw, Chairman of the Devon County Council.

UNDERGROUND GASIFICATION OF COAL*

By HAROLD ROSE, B.Sc., A.I.C., A.M.I.Chem.E.

THE idea of converting coal to gas in the seam is not new. The possibility was first mentioned by the Russian chemist, Mendeleev, in 1888, and somewhat later by Sir William Ramsey in this country. Although the idea attracted a certain amount of attention in other countries, little practical work was carried out beyond the laboratory stage. In fact, no country took the matter seriously until Lenin, attracted by the project outlined in the British Press in 1913, coupled the problem with the plan for electrifying the U.S.S.R. The Soviet authorities were immediately attracted to the advantages which the scheme offered.

By utilizing poor seams of low quality coal, which were uneconomical or impractical to work, their potential coal reserves could be increased enormously. The reduction in the transport of coal over long distances would be a great advantage to such a vast country as Russia, where fuel supply has to be transported over hundreds of miles as a matter of course. The elimination of underground mining would provide cheaper fuel and power, which would, in turn, influence all industrial activities. The provision of low cost gas as a possible source of raw materials for the production of synthetic fuels and chemicals offers an additional attraction, and not the least important is the enormous amount of arduous human labour which would be saved, as a result of which society as a whole would reap benefit.

Experiments on single shafts were first carried out in 1933 in the Donetz Basin, and gradually the work extended to experimental stations, first built in 1937; finally, in 1940, the first industrial station was opened in the Moscow Basin. The Third Five Year Plan, 1938–1942, incorporated a project for the construction of several new plants in the Donetz and Moscow coalfields, in the Urals, Eastern Siberia, in Central Asia, and the Far East. Provision was made in the plan for the building of two stations where the control of the plant could be carried out automatically in a central control room. To give some idea of the size of these industrial plants, the projected station at Lisichansk, in the Donetz, was expected to have a daily output of 20 million cu.ft. of gas, with an average calorific value of 275 B.Th.U. per cu.ft. Two other stations with a daily output of 14 million and 8 million cu.ft. respectively were included in the project.

In the first experiments the seam was converted into a number of underground gas producers, by first reducing one or more panels to fragments before ignition. This method, however, was found to be unsatisfactory, and was abandoned in favour of methods which reduce underground mining operations to the minimum.

There are at least three methods available, each of which is applicable to a particular type of seam, the deciding factors usually being the inclination and depth of the seam.

(i) *Stream Method.*—This is perhaps the most successful and firmly established of all methods, and is particularly suited to steeply inclined seams. A gallery, which acts as the fire shaft, is driven along the seam, and two shafts some 200 to 300 yards apart are taken upwards along the seam to the surface. The coal is ignited and combustion maintained by blowing compressed air down one shaft, the combustible gas being tapped off at the second shaft. In this way the fire burns progressively upwards along the seam to the surface. Starting-up usually takes from two to ten hours, after which gas is produced continuously without further attention.

At one experimental station in the Donbas, working on a 6 ft. thick seam, inclined at an angle of 75°, gas was produced without interruption for 18 months, during which time 250 million cu.ft. of power gas and 70 million ft. of synthetic gas were produced.

(ii) *Filtration Method.*—This method is used for horizontal seams and requires no preliminary underground mining operations. A number of bore-holes, reaching to the seam, are arranged in concentric circles, and air is pumped down through the centre boring, the gas being withdrawn from the bore-holes of the first ring. When the gasification of this section is complete, the air is then pumped down the first ring of borings and the gas withdrawn from the next concentric ring. The bore-holes are interconnected, so that the gas underground passes through cracks and crevices from one bore-hole to those adjacent to it.

(iii) *Bore-holes and drilling method.*—This virtually is a combination of the previous two methods, and is considered suitable for gently sloping seams. If a low-grade coal is used, the air may be enriched with oxygen, or, if steam is added to the blast, a semi-water gas is obtained.

Some of the gas penetrates into faults in the seam and to the surrounding rock. This gas may be recovered by discontinuing the air blow while the gas is being pumped off. A gas rich in hydrogen is obtained in this way, which is eminently suitable for the production of synthetic fuels and chemicals.

The process can be divided into two cycles. During the air blow, power gas with a calorific value of 115 B.Th.U. per cu.ft. is obtained, while during the blow-off period a synthesis gas is obtained with a calorific value ranging from 170 to 220 B.Th.U., and with a hydrog content which might reach 55%. If the air blow is enriched wi oxygen up to 25%, these calorific values may be increased by 50% more.

If we can judge from the considerable amount of expenditure research and development in the U.S.S.R., and from the resu published, it would appear that, although major technical proble yet remain to be solved, the teething troubles are over and the und ground gasification of coal may be considered as an established fac

Most of the published results are based on the operations of t large experimental station at Gorlovka, in the Donetz, and some these are worthy of study. Whereas the monthly output of ea miner in this Basin is 30 tons a month, the output of each operati at the underground gas station, in terms of coal equivalent, is 75 ton thus, the productivity of each operative is more than doubled. If th figure can be achieved at an experimental station, it has been estima that a large industrial station can increase the output per operator 12 to 15 times as compared with conventional mining methods.

Since 80 to 90% of the fixed capital goes into surface work, and t remainder into the preparation of the panel, there is a considera saving in the cost of operation, which has, in fact, already led to reduction of the cost of power gas to one-third of its usual cost.

The possibilities that present themselves are great. In the fi place, shallow seams and poor deposits of coal, which cannot be pr fitably worked by conventional mining methods, could be successfu dealt with by underground gasification.

The gas plant, now transferred to the pithead, could distribute lo cost gas to industry, which might be handled through a regio scheme, along the lines of a gas grid. Alternatively, the gas may used for cheap power generation on the site by means of a gas turbi The Kharkov Mechanical Engineering Institute has, in fact, brou out the first industrial gas turbine which will operate exclusively underground gas. The power generated can be linked up with t existing grid, and will incidentally supply the requirements of t station itself and the industries centred around the station, using raw materials the products of gasification. For it is in this directi —the utilization of the synthesis gas for the production of industri fuels and chemicals—that the process offers so much promise. T gas produced provides the basic raw material for the synthe production of a number of key industrial chemicals.

We can envisage the possibility of replacing the monstrous sl heaps at the pithead by highly mechanized gas stations, coupled wi thermo-electric and electro-chemical enterprises, running on che power, together with a group of synthetic chemical industries, t whole forming one integral unit running entirely on the gas generat from the seam, without a human hand having to touch the raw co The installation of such centralized industrial combines is bound have a marked effect on industry as a whole by stimulating new indu tries and by the general lowering of the costs of production.

The Gas Industry might well take the trouble to investigate t possibility of gasifying coal underground in this country. The tec nicians we have. What we require are foresight and the establishme of adequate funds to enable the necessary scientific research to b carried out.

* Abstract of a Lecture at a Conference of the North-Western District of the B.C.G.A., Manchester, May 28.

Parkinson & Cowan, Ltd.

A profit of £48,423 for the year ended Dec. 31, 1942, compared wi £45,395 for the previous year, was recorded at the annual meeting Parkinson & Cowan, Ltd., in London, on May 26, when an Ordina dividend of 5%, less tax, was declared. In his statement to the shar holders, Lt.-Colonel H. W. Woodall (Chairman) pointed out th increased turnover and profit bore little relation to the amou available for distribution, in view of the heavy provisions necessa for taxation. Although the profit of the trading subsidiaries amount to £234,792, only £61,208 was left as net profit for the year aft provision for income tax, E.P.T., and reserves for deferred repair The activities of the Companies operating in Australia had be severely restricted by the war situation, but, while difficult times wou undoubtedly continue, the position was improving, and every effo would be made to recover the situation in the shortest possible tim

Due to the exigencies of the war, the Company's efforts had be almost exclusively directed to wartime production, but in spite of th serious thought and attention were being given to post-war problem The works were operating on a scale of engineering and scienti efficiency much in advance of pre-war requirements, an advance whi should place the Company in a greatly improved position to hand post-war problems. In these times, when every day brought its o man-power problems and when every fresh development of the fighti services was immediately reflected in altered industrial requiremen the Company's thanks were more than ever due to the staff and wo people for the efficient and unflagging energy they brought to b upon their tasks.